AN OGDEN PUBLICATION DEVOTED TO GLASS TECHNOLOGY, ENGINEERING, MATERIALS AND GLASS FACTORY EQUIPMENT AND OPERATION

the glass industry

CONTENTS FOR JULY : 1955

Bubbles in Glass—The Problems and Some Approaches to Its Solution ... 357
Circumstances and conditions of bubble formation in practice and the results of statistical quality control analyses are discussed in this paper. By Ralph K. Day.

The Analysis of Ancient Glasses 362
The need for utmost precision in the analysis of ancient glasses is emphasized in this short article. By W. E. S. Turner.

The German Export of Glass and Glassware to North, Central and South America 363
Some statistics on the exportation of glass and glassware from West Germany during 1954. By Erwin Stein.

Recent Translations of Russian Papers of Interest to the Glass Industry ... 366
Abstracts of several papers translated from the Russian journal of the glass and ceramic industries.

Inventions and Inventors 371
A summary of recently issued patents of interest to the glass industry.

Research Digest 373
Moisture-condensation patterns is the subject reviewed this month, with details of a method whereby the breath film was preserved sufficiently long for a detailed study.

Current Statistical Position of Glass 377
Production, shipments and employment in the glass industry during April and May 1955.

New Equipment and Supplies 379

Editorial and Executive Offices:
OGDEN PUBLISHING COMPANY 55 WEST 42ND STREET, NEW YORK 36, N. Y.

JOHN T. OGDEN, Publisher
CYRIL B. DELGADO, Editor and Business Manager
KATHERINE A. HOWE, Production Editor
BENJAMIN J. WALDECK, Circulation Manager
Midwest Representative: Macintyre-Simpson & Woods
Chicago office: 75 East Wacker Drive
Cleveland office: 1900 Euclid Avenue

Copyright, 1955, Ogden Publishing Co.

The GLASS INDUSTRY, Vol. 36, No. 7, July 1955, Published monthly by Ogden Publishing Company, Emmett Street, Bristol, Connecticut. Editorial & Executive Offices, 55 West 42nd Street, New York 36, N.Y. Subscription $4.00 a year. Canada and Foreign, $5.00. Single copies 40 cents domestic, 60 cents Canada and Foreign. Issues over three months old 60 cents; over one year, $1.00. Entered as second class matter January 25, 1955, at the Post Office at Bristol, Connecticut, under act of March 3, 1879.

Engineering Holds the Key

TO GROWTH OF THE AMERICAN ECONOMY

Engineering in the field of industrial research and new product development is the main source of future economic expansion. This is dramatically illustrated in the Glass Industry, the past history of which may well presage its future. Glass progress through the years has been marked by a spectacular broadening of its applications to enhance the standard of living everywhere.

Keeping stride with this complex and versatile industry, with its pace-setting trends and bold advancements, has earned Frazier-Simplex a world wide reputation in the field of glass house engineering.

As in the past 37 years, the Frazier-Simplex organization stands ready to assist in translating your new glass product developments into manufactured realities.

COMPLETE GLASS PLANTS AND EQUIPMENT
DESIGNED FOR LOCAL CONDITIONS AND CONSTRUCTED TO MEET
YOUR INDIVIDUAL PRODUCTION REQUIREMENTS . . . ANYWHERE

Write or wire today on your particular needs

SIMPLEX EQUIPMENT

Complete Plants

Tank Furnaces • Batch Chargers • Batch Handling Systems • Producer Gas Plants
Decorating and Annealing Lehrs • Stackers

FRAZIER-SIMPLEX, INC.
Engineers
436 EAST BEAU ST. WASHINGTON, PA.

the glass industry
VOLUME 36, NUMBER 7, JULY, 1955

Bubbles in Glass - The Problem and Some Approaches to Its Solution

By RALPH K. DAY
Libbey-Owens-Ford Glass Company, Toledo, Ohio

Abstract

Due to the forces of surface tension, bubbles in glass try to be round and they cannot form to relieve supersaturation in the glass melt except at points of inhomogeneity. The mechanics of bubble formation are analyzed. Theory coupled with experimental evidence indicate that the problem is larger than mere removal of residual melting bubbles by Stokes' Law rise. The circumstances and conditions of bubble formation in practice are discussed. Statistical quality control analyses of bubble counts are presented illustrating that correlation with causes by empirical statistical methods is a means of finding and confirming suspected causes.

It seems to me that the first thing we have to do in approaching the solution to a difficult problem is to orient ourselves. We've got to appraise our problem and we've got to define our terms. To control bubbles in glass, we've got to know what they are and how they are formed or where they come from. If we can then separate the facts from the "think-so's," we will be on the road to formulating an approach to getting rid of them. I am going to discuss principally this orientation phase of our subject, Bubbles in Glass, and try to throw some light on defining the problem and what we know and don't know about it.

What is a bubble anyway? Why is it round or sometimes elongated? The answers to these two questions are not controversial. A bubble is a globule of air or gas within a liquid (Webster). A bubble is round or tries to be as round as it can because surface tension forces try to make it round.

Surface tension is a force per unit of length. As you grab a piece of paper in both hands and stretch it, the tension in the paper is the force between your hands per unit of paper width. Positive surface tension wants to shrink a surface to the smallest area it can possibly achieve and this causes any volume of gas or air which has been trapped in the molten glass to try to become a spherical bubble. When the soft glass is rapidly stretched during cooling, as for instance in the case of commercial window glass, the spherical bubbles may become elongated simply because they have not got time to become spherical again before their shape is frozen in the cooled glass.

We also know quite a little about the rate of rise of bubbles in a liquid. Stokes' Law relates the rate of rise of bubbles directly to their squared diamenter, directly to the glass density and inversely to its viscosity. This law has been tested and found to be exact, provided that the container walls are relatively distant. As an example, a temperature drop from 2450°F. to 2000°F. in a soda-lime glass causes a ten-fold increase in viscosity thus slowing down the rise of bubbles by a factor of 10. Similarly, a temperature rise of about 125°F. in that same temperature region will double the rate of rise. On the other hand, an increase in bubble diameter from .003" to only .010" (square law) speeds up their rise by a factor of 11. Unusual glass compositions will have their own characteristic viscosity curve which can be quite different from the above. I have qualitatively observed that in the case of platinum crucible melts, the higher the temperature, the larger are the residual bubbles in the final glass. Perhaps some of you have quantitative information on this subject with respect to your own glasses.

Presented before the Fifteenth Conference on Glass Problems, Ohio State University, Columbus, Ohio.

Here are some facts we can use. Assuming that we start with supersaturation of gases from the batch and that these gases have to be eliminated from our glass by bubble formation, explosive gas emission into fewer big bubbles at higher temperatures will make for a more rapid elimination by Stokes' Law rise. And this adds up to theoretically checking the phenomenally rapid melting and fining of glass batch which are observed in platinum crucible melts at very high temperatures[1]. If you believe in measured facts and their logical assembly into conclusions, we have just argued ourselves into concluding that high temperature melting is very desirable for rapidly fining glass. Perhaps we should add the phrase, "other things being equal."

Now to my mind the most important thing about bubbles in glass is their conception. How are they created? It will seem to some that the most important thing is to get rid of the bubbles which are in the molten glass, but trying to be logical again, whether it is more important to get rid of them or to prevent their formation depends on whether most bubbles in glass are residuals; that is, left over from the original boiling of the batch, or if bubbles are reintroduced later in the process. Further on, I will give some reasons why I think that the objectionable bubbles in glass are not always residuals, and that is why I believe that a study of bubble formation with an eye toward controlling their formation is so important.

Theoretically it is impossible to start a bubble in a homogeneous fluid. That's fine. We all want homogeneous glass and our commercial glass is probably homogeneous enough most of the time to satisfy the physicist's statement which was just mentioned.

[1] "Glass Research Methods," R. K. Day, pp. 199-204, Industrial Publication (1953)

[2] "Handbook of Glass Manufacture," p. 36, Ogden Publishing Co., New York, (1953)

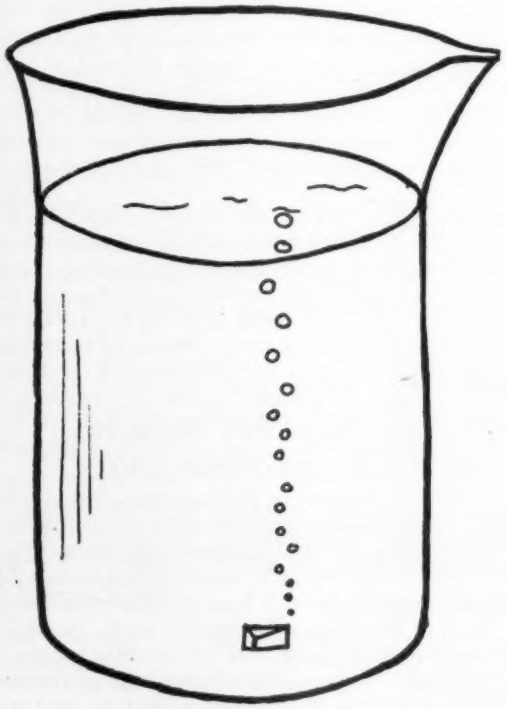


FIG. 1

Before we go on, let us try to illustrate this impossibility to start a bubble in a homogeneous medium. If I place the rubber eraser at the end of my pencil to my lips and blow, I cannot blow it into a balloon; I am not strong enough. Now watch the color of my face as I try to blow up the rubber balloon. I am expecting to have to give it all I've got to get it started. After I get a little air into it, the rest is easy. To put it mathematically, the pressure P inside of a bubble is equal to $\frac{4T}{r}$ where P is the pressure in the bubble, r is its radius and capital T is the surface tension.

$$P = \frac{4T}{r}$$

If the surface tension stays the same, the smaller the radius, the greater the pressure.

Sharp and Badger tell us that "Commercial glasses possess surface tension values at 1200°C. which usually lie in the range of about 245 to 320 dynes per cm." and that "The temperature coefficient is usually from –0.02 to –0.04 but may be zero or positive for some lead borates."[2] For our present purposes, let us be satisfied that Sharp and Badger have told us that we always have some surface tension in molten glass and, as a matter of fact, we must admit from the figures given that surface tension varies less in amount than do most glass properties.

If you are now sure that glass always has some surface tension, you can see mathematically or visualize physically that when r, the bubble's radius, is zero, the pressure in the bubble or the pressure required to start the bubble is *infinite!* Now infinity is an awful lot. A bubble doesn't just require a strong man to blow it into existence. It doesn't just require a very high vapor pressure to start it. The formula says that when the bubble has zero size, the pressure inside is infinite and the only loophole which the formula leaves to allow bubbles to be created at all is the adjective "homogeneous." "Theoretically it is impossible to start a bubble in a homogeneous liquid." Have I proven, at least theoretically, that inhomogeneity is the cause of bubble creation? Have I proven that inhomogeneity must be present for bubbles to form at all?

Now let us look at some experimental observations. Undoubtedly you have all boiled water in a beaker or have noticed water starting to boil under circumstances where you could hear it growl and bump. If you put a piece of inhomogeneity such as a piece of porous porcelain into the beaker, the bumping stops immediately. You are, in fact, liable to start such rapid bubble formation as to cause an immediate boil-over. If you will now turn the fire down so that the water just simmers, you will notice that all the bubbles which constitute the now quiet boiling are created at the piece of porous porcelain and rise in a steady stream upwards from it. This experiment is a good demonstration of how bubbles like to form at rough surfaces or interfaces and don't like to start even at the smooth interface of the water with the glass beaker. The bumping in the beaker just as the whining of the tea kettle just before boiling are evidences of overheating. We might say that the water is supersaturated with steam at this temperature just above its boiling point, and each new steam bubble which wants to form to help relieve the supersaturation has to find a speck or other inhomogeneity to get started on.

The availability of nuclei to allow bubbles to start is a measure of what might be called the opportunity for bubbles to be formed. We should also look into the potential or vapor pressure which is a measure of the tendency toward bubble formation. Cold water doesn't boil steam bubbles until it is heated to its boiling temperature no matter how much porous porcelain you put in, but a tumbler of tap water will often develop air bubbles clinging to the inside wall of the tumbler after standing. Another way of saying the same thing is that the cold tap water has a water vapor pressure of less than an atmosphere and it is at the same time supersaturated with dissolved air. The tendency of the water to evaporate is measured by its vapor pressure divided by the pressure of the air above it. The tendency of the air to come out of the solution is measured by the per cent of air in the water as it comes out of the tap under pressure divided by the solubility of air in the water at the room temperature. Molten glass presents a slightly more complicated problem, but perhaps there is considerable similarity to the problem of the tumbler of tap water.

We have no reason to believe that our physical chemistry laws are violated in molten glasses. The phenomenon of vapor pressure lowering and boiling point raising in mixtures compared to pure liquids is one reason why our best glasses contain so many different ingredients. Use of these laws and evaluation of the constants is generally complicated by the fact that the process time of melting and forming is often shorter than the time needed to achieve the equilibrium conditions to which the laws apply.

We do, however, have a few facts on this subject of vapor pressure of gases in our molten glass. For instance, the flue gas atmosphere in a natural gas-fired tank contains about 20% water vapor while the usual air atmosphere over electrically melted glass contains almost no water vapor. A correspondingly greater dissolved water content would be expected in the glass which was melted under the higher partial water vapor pressure. That such a relationship holds for dissolved water vapor has been confirmed by several laboratories. Dalton of the Corning Glass Works also made the statement that soda-lime glasses are inclined to be supersaturated with CO_2 gas which is slow in diffusing through the glass to existing bubbles and surfaces. He quotes a lowering of 2:1 in the dissolved water content between a 100 pound gas-fired melt and a 100 gram (1/5 pound) laboratory melt in air atmosphere, but the carbon dioxide content of both melts was not only nearly equal but more than ten times greater than the equilibrium value measured by Weyl under a 100% CO_2 atmosphere.[3] The total volumes of these gases dissolved in glass are not insignificant either, being of the order of equaling the volume of the glass itself at atmospheric temperature and pressure.

It is also the rule in physical chemistry that vapor pressures are higher at higher temperatures and lower at lower temperatures. These laws imply that if the glass

[3] ibid. loc. cit.

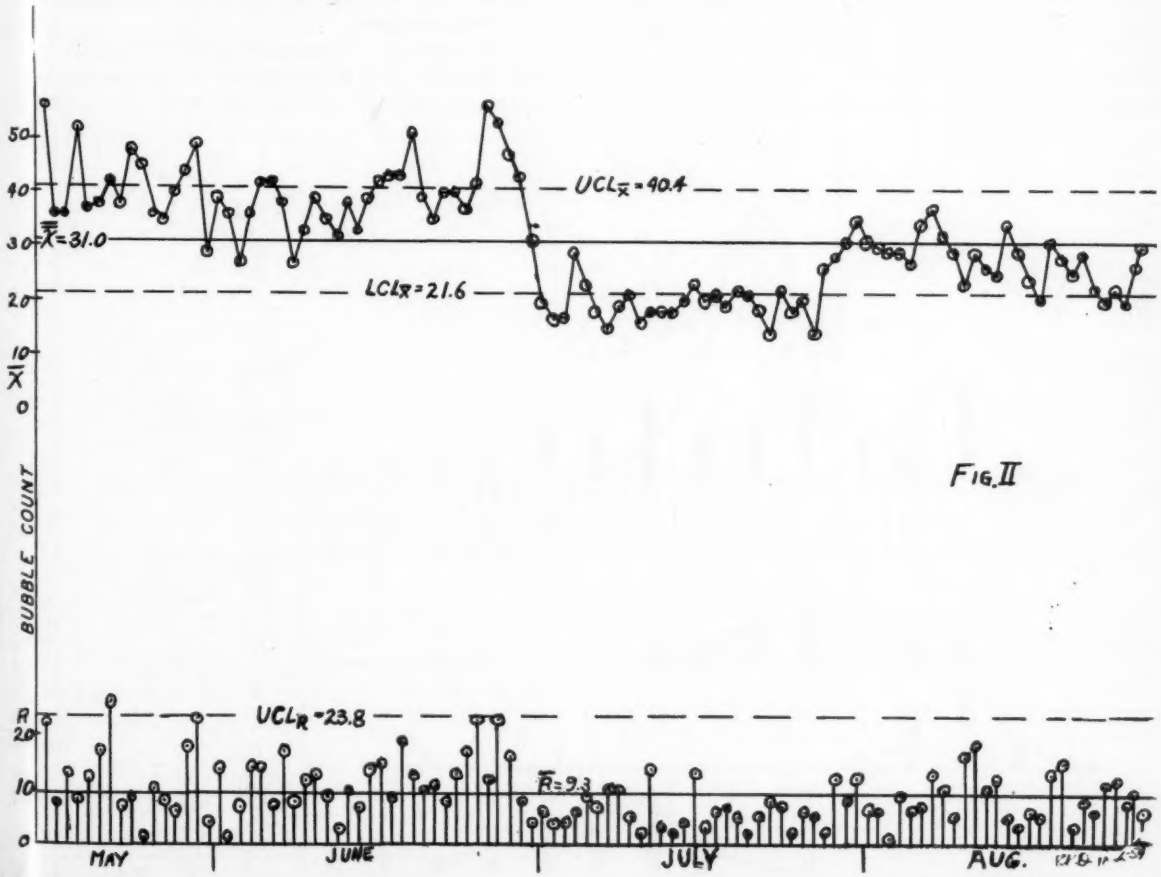


FIG. II

has been melted bubble free to equilibrium at the highest temperature of the tank, the tendency to bubble formation at lower temperatures should be so small as to be of no importance. This would be true if the process remained the same. Such reasoning should cause us to arbitrarily point our fingers of suspicion toward changes which do take place in the melting process such as, for instance, floating salt water or any kind of floating scum, devitrification or solution of chemically different refractories.

I am reminded of the story my father used to tell about the steaming lava which was seen to flow down the side of the volcano and into the sea, at Hawaii in particular, I think. Photographers took color pictures and many people observed the slowly moving lava which glowed dull red at night until it boiled the ocean as it entered the water. This lava is a glass. Samples taken to the laboratory would not even soften in a platinum resistance furnace and the chemical composition was such that you would certainly not expect it to be flowing down the mountain glowing only a dull red during the night. Some samples which I have seen were also free of bubbles, yet there must have been a terrific loss of dissolved gases during the cooling to account for this extreme change in physical properties.

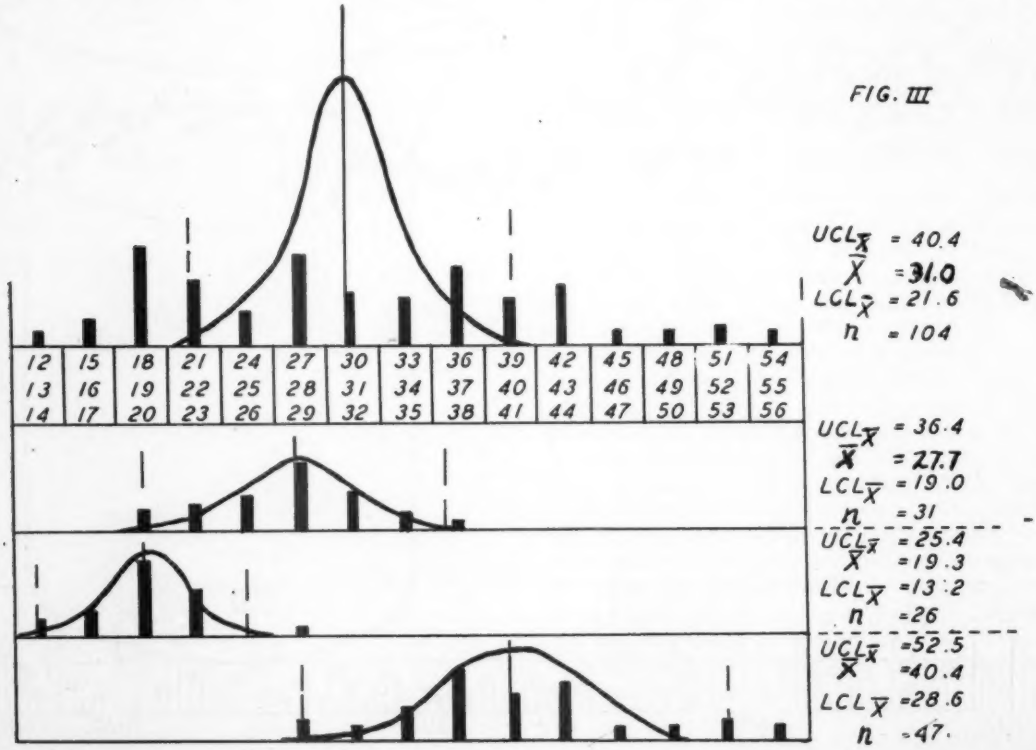
In laboratory crucible melts some years ago at Corning, I found out experimentally in platinum-rhodium crucibles that a certain commercial glass batch could be melted at 1400°C. and in just 2½ hours the melt was observed to be free of bubbles. If the melt was removed from the furnace after less than 2½ hours, bubbles were still present and after any melting time longer than 2½ hours, bubbles continued to be absent. Repeating the same experiment identically but with a very small piece of a certain refractory material added to the melt, after holding the melt at 1400°C. for as much as 48 hours, bubbles still persisted. After such melts were cooled and the sections were polished, it could be seen that the bubbles were starting only at the small pieces of refractory which had been inserted and were rising to the top in a steady stream just the way the steam bubbles in the beaker boiled from the porous porcelain. It is this experiment probably more than any other which causes me to believe that objectionable bubbles are liable to be formed after the melting process and be present in the glass product in addition to any residuals which may be left from the original melting of the batch. How can that experiment be interpreted other than as molten glass which is supersaturated with gas and which was aided in ridding itself of the supersaturation by the presence of the refractory interface.

Now don't let us draw hasty conclusions. Maybe the refractory made the glass seedy. Maybe the refractory helped the glass rid itself of excess gas at a temperature where the bubbles could get out and in this way give us a glass which could stand more abuse later at lower temperatures with less tendency toward late bubble formation.

Another interesting phenomenon about bubble formation which has vexed all of us and which is really a little difficult to explain is *reboil* in glass cullet when it is remelted. Most of you have undoubtedly experienced reboil and I don't know yet whether all cullet when reheated is liable to reboil, or even if it must be reheated hotter than its original melting temperature for it to develop that myriad of very fine bubbles and seeds throughout the previously fined glass.

Now let's test this experience against my thesis that bubbles can only form in the presence of inhomogeneities. It looks very much as if I have got myself into a tough

FIG. III



spot to try to explain reboil in a piece of homogeneous glass cullet. There is a situation here which must be faced directly. I've got to either get myself out or give up the theory. A theory isn't much good if we have to admit even a single clear experimental exception. Frankly, the only mechanism that I can think of to explain this apparent discrepancy is the possibility that the inhomogeneities which help the bubbles of reboil get started are those lattice defects about which we hear so much in solid state physics these days. We might even go so far as to cite this phenomenon of reboil in homogeneous cullet as evidence that there must be some discontinuity, such as lattice defects, present to allow reboil. I am still very sure that bubbles can't get started without a speck or crystalite or gap of some kind in the otherwise apparently homogeneous cullet and those of you who have experienced reboil in cullet will, I think, agree with me when I say that it is not a very reproducible phenomenon —sometimes it does and sometimes it doesn't, depending probably on the degree of packing or other measure of the available nuclei present.

You are probably all familiar with the flat glass people's name for devitrification. We call it dog-metal or sometimes just plain dog. When a crystal separates from a liquid, that is certainly an inhomogeneity. There may be some in this audience who share my belief that seeds can be formed in the working end of a tank as a result of the dog-metal that is redissolved.

I had remembered hearing about a process of obtaining bubble-free fused quartz by melting quartz sand into its usual bubbly opaque mass and then before cooling, applying enough pressure to "squeeze out the bubbles." Don Sharp, when he heard that I couldn't find reference to it, loaned me his reprint of the article written by my own father and Dr. Shepherd of the Geophysical Laboratory in April, 1906.[4] (Perhaps I may be excused for not remembering it accurately for I had my second birthday later that year.) In the final paragraph of this article was written:

> "Summing up the conditions for preparation of good quartz glass, we find them to be: An initial temperature of 2,000° (C.) or more, without pressure, to produce sufficient quartz vapor to drive out the air from between the grains, followed by pressure (at least 500 pounds), and a reduced temperature (perhaps 1800°), with time for the quartz to flow compactly together without being attacked by the graphite."

That is quite interesting and is another example of good old-fashioned vapor pressure chemistry. It was mentioned in the article that the vaporized quartz could have been a reduction of SiO_2 by graphite to silicon metal, which evaporated and later reoxidized to silica quartz. Today we would reason similarly but include our knowledge of lower oxide of silica in the explanation.

[4] Arthur L. Day and E. S. Shepherd: "Quartz Glass," *Science* N. S. Vol. XXIII No. 591 pp. 670-672–April 27, 1906

(*Continued on page* 386)

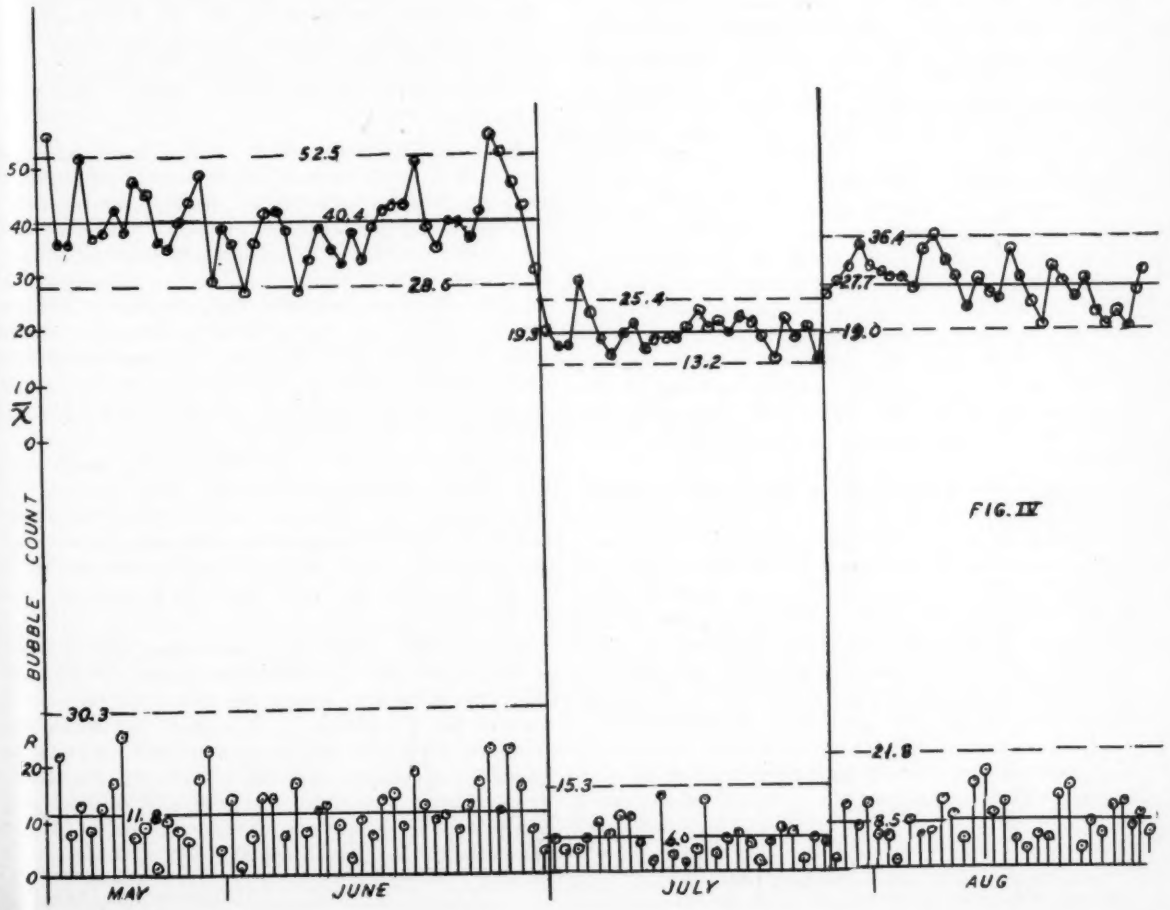


FIG. IV

The Analysis of Ancient Glasses

By PROFESSOR W. E. S. TURNER

● INCREASING INTEREST is being taken by glass technologists, by archaeologists and the general public in ancient glass, and in its history, through a period of some 4,000 years. Much of the story is still obscure. It is to be hoped that excavations in the Near and Middle East may, stage by stage, fill in some of the gaps in our knowledge. While waiting for such further information, archaeologists and historians of glass have come to recognize that a good deal may be learned by a survey and comparison of the specimens known to exist in the museums of the world. Such a survey has indeed already been begun under the auspices of an International Committee on Ancient Glass, the initiator and chairman of which is Ray W. Smith, an American citizen whose exhibitions from his own collection of glass of the Roman period have been staged in the U.S.A., in Germany and in Belgium and have aroused much interest. In such a survey it is essential to note many points of technique, and a determination of the composition is desirable. Our knowledge of compositions is by no means as full as has been imagined, and only in a few cases, such as the studies by Professor B. Neumann in 1925-27, has that knowledge been acquired systematically. There is a wide field for work in this region of determining ancient glass compositions, and as there are special conditions under which such work should be carried out, it seems desirable to give some guidance at this junction to any collaborators who are willing to take an interest in the subject.

It needs to be emphasized at the outset that the analyses required must be precise in character and the work necessary should, therefore, not be remitted to analysts who have not yet acquired high skill and habits of precision. Some specimens of ancient glass are too fragmentary to be squandered by unskilled analysts. There has been advocacy in some quarters for the use of spectrographic methods in work of this character. Archaeologists like C. G. Seligmann and A. G. Beck[1] have written enthusiastically of these methods.

Spectrographic methods are of great value in certain respects but they also have serious limitations. They can be applied to small quantities of material and have special usefulness in the detection and approximate determination of minor constituents and trace elements which are so laborious to determine by chemical means. The major constituents of a glass, however, can often only be determined spectrographically in a semi-quantitative manner as lying between two limits which may be several per cent apart. It needs to be emphasized, however, that at the present stage of our knowledge, each specimen should be treated as in a piece of research and the utmost precision given to the analytical operations. If this is the case, there seems to be no alternative but to use chemical methods of analysis supported where desirable by spectrographic determinations for minor constituents.

The composition of many specimens of ancient glass is comparatively complex. The majority of the glasses which have come down to us from ancient Egypt and the Near East are based on the constituents silica, calcium oxide, magnesium oxide, sodium oxide and potassium oxide, together with varying amounts of alumina, iron oxide and titania. In some Assyrian glasses of the early sixth century B.C., some late Egyptian glasses of 200-100 B.C. and some Chinese of the pre-Han or Han period (202 B.C.-220 A.D.), lead oxide has been found as a major constituent and, in the Chinese glasses, barium oxide also. Many of the most ancient glasses are colored and the reagents which give rise to them must be sought for and determined. The most frequent are copper, iron and manganese and, much more rarely, cobalt.

This does not complete the already long list of constituents which need to be borne in mind in making an analysis. There are others to be looked for which arise from the raw materials employed, of which the two essential constituents for many centuries were sand and ash.

Some of the sands used in ancient times—probably most—were far from consisting of pure silica, while the plant ash, the source of the alkalies, was invariably of complex composition and contained also silica and the alkaline earths in abundance. Moreover, the alkaline elements were present not only as carbonates, but also as chlorides, sulphates and phosphates and the alkaline earths in several combinations. A careful analysis requires therefore that the chloride, sulphate and phosphate content of the glass shall be determined. Upwards of 4 per cent of P_2O_5 and upwards of 2 per cent of SO_3 have been found in some glasses.

Two other constituents are possible: antimony oxide and volatile material, particularly water. Ancient Assyrian glasses and some (according to M. Farnsworth[2] and P. D. Ritchie, many) ancient Egyptian glasses contain antimony oxide and this constituent should be sought for. Arsenious oxide has only been found with comparative rarity.

The material volatile on ignition may include gases in solution and water, of which the former will probably affect the analyses by weight but to a small extent. The water content, however, is important, for during the course of centuries, dependent on climate—that is, on humidity, on temperature and temperature fluctuation, or on contact with water or moist soil—a glass may slowly take up water to a considerable extent. It has been demonstrated experimentally that up to a certain

(*Continued on page* 383)

[1] "For Eastern Glass: Some Western Origins," Bull. No. 10, Museum of Far Eastern Antiquities, Stockholm, 1938, pp. 1-64.
[2] Technical Studies, 1938, **6**, 155-168 and Tables I-V.

The German Export of Glass and Glassware to North, Central and South America

By ERWIN STEIN, BERLIN, GERMANY

● THE EXPORT RESULTS of 1954 in the group of glass and glassware, stated by the "Statistisches Bundesamt" for West Germany (including West Berlin), show in the value of the exports an increase of 150% since 1952. Of this increase of export turnover, $4.30 million are apportioned to glass and $11.16 million to glassware, or a total of $15.46 million. In this way, the total turnover in 1954 reached more than $45 million (Table 1).

In many cases, the U.S.A. is the most important customer of the German exports; i.e. plate glass with 30% (cut or polished), flat glass with 27%, optical glass with 15%. In the tables, we give the figures for 1954 in comparison with those of 1953, and we show the increase of the turnover, amounting to $142,000 for glass rods, balls, etc.; $544,000 for cast glass, unfinished; $203,000 for safety glass. On the other hand, there is a decrease in the export of optical glass amounting to $200,000 (Table 2).

After stating that the U.S.A. had, with half a million dollars, the greatest part in plate glass, there are in glassware (finished goods) two positions with a value of a million dollars or more, i.e., $5 million ($220,000 more than 1953) for glass petty goods, glass eyes for animals. These are 59% of the West German total export and $1.68 million for exports to the U.S.A. ($400,000 more than 1953) for glass and glassware, domestic purposes, finished, or 27% of the German sales abroad. In other cases, the U.S.A. took 5-6% of glassware for domestic purposes, not treated, 16% of illumination glass, 6-7% of glassware (hygienic and pharmaceutical purposes, 15-16% of optical glass (Table 3).

TABLE 1

Export	Year	Tons	Dollars
Glass	1954	63,360	11,638,000
	1953	48,800	9,195,000
	1952	343,000	7,339,000
Glassware	1954	72,000	34,000,000
	1953	55,600	26,516,000
	1952	51,900	22,835,000
TOTALS	1954	.....	45,638,000
	1953	.....	35,711,000
	1952	.....	30,174,000

TABLE 2

Export	Year	Tons	Dollars
Glass rods, balls, etc...	1954	2,689	1,101,000
	1953	1,926	859,523
Of this total, export to:			
Brazil	....	81	51,150
Chile	....	48	20,200
Argentina	....	10	7,620
Venezuela	....	5	3,100
U.S.A.	....	1	3,330
Cast glass, unfinished..	1954	14,491	1,735,700
	1953	10,372	1,191,666
Of this total, export to:			
U.S.A.	....	597	84,050
Venezuela	....	136	20,240
Colombia	....	171	29,740
Br. West Indies ...	....	150	18,100
Canada	....	118	15,500
Peru	....	80	13,330
Brazil	....	53	10,710
Cuba	....	14	3,950
Guatemala	....	11	2,380
Plate glass, cut or polished	1954	5,672	1,678,500
	1953	5,872	1,679,523
Of this total, export to			
U.S.A.	....	1,937	505,500
Brazil	....	413	163,000
Canada	....	331	94,500
Argentina	....	258	59,500
Uruguay	....	36	13,300
Panama	....	27	13,200
Flat glass (sheet glass), finished	1954	554	460,000
	1953	299	465,238
Of this total, export to:			
U.S.A.	....	17	127,130
Canada	....	19	15,240
Venezuela	....	33	10,500
Colombia	....	3	8,010
Safety glass	1954	1,035	635,700
	1953	653	432,142
Of this total, export to:			
Colombia	....	105	50,070
Canada	....	95	38,330
Peru	....	54	21,430
Cuba	....	17	9,090
Glass for optical purposes, optical not treated	1954	197	811,200
	1953	175	1,020,238
Of this total, export to:			
U.S.A	....	15	124,050
Argentina	....	15	41,900
Uruguay	....	1	4,050
Mexico	....	1	3,810

On behalf of the shares, valid for the American continent, the U.S.A. is in first place as far as the export of the German Federal Republic is concerned. Export value, which has reduced about $15,000 since last year, is still more than $700,000 higher than in 1952. For Canada, the turnover is four times higher during these years, but in Argentine it reduced itself by nearly $200,000. This means that the total export of the glass group participating is: U.S.A. ($11.63 million) with 17%; Canada with 6%; Argentine with a little more than 1%; Colombia with 2%; Venezuela with a little lower percentage, as well as Brazil. The last mentioned three countries have increases of their turnover of more than $100,000. Otherwise the shares of lower exports doubled. In other cases, the turnover decreased, i.e., in Chile 62%; in Peru 61% (Table 4).

Most of the glassware groups are much higher. As far as the U.S.A. is concerned, it has a turnover of more than four times as the figure increased $900,000 since 1953. At the same time, Canada has a plus of $250,000, as well as the Brit. West Indies and Brazil. In several cases, increases of the turnover of about $50,000 or more can be shown; i.e., Cuba, Uruguay and Venezuela. For the export of glassware, West Germany reached a total turnover of $34 million. Therein the U.S.A. participated with 26%, Canada with 2%, Mexico with 1%, Brit. West

TABLE 3

Export	Year	Tons	Dollars
Bottles, glass preserve jars, unfinished ...	1954	51,753	519,600
	1953	42,563	400,447
Of this total, export to:			
Br. West Indies .	....	1,989	232,600
Venezuela	....	1,053	182,800
Colombia	....	424	70,000
Dominic Rep. ..	....	152	56,700
Costa Rica	....	277	39,050
U.S.A.	....	41	11,400
Glassware for the household, not treated (domestic purposes	1954	8,879	2,318,000
	1953	5,422	1,476,666
Of this total, export to:			
U.S.A.	....	86	128,300
Canada	....	154	96,400
Venezuela	....	22	22,850
Ecuador	....	64	20,710
Br. West Indies .	....	92	16,400
Colombia	....	4	10,950
Glassware, for domestic purposes, finished	1954	3,793	6,246,000
	1953	2,388	4,314,761
Of this total, export to:			
U.S.A.	....	805	1,688,000
Canada	....	166	237,400
Brazil	....	107	195,200
Mexico	....	41	126,600
Colombia	....	19	59,520
Cuba	....	20	38,570
Ecuador	....	10	24,750
Salvador	....	4	23,810
Peru	....	8	21,190
Guatemala	....	6	18,800
Uruguay	....	7	17,140
Costa Rica	....	5	14,760
Illumination glass, signal glass	1954	2,367	2,178,500
	1953	1,235	1,253,809
Of this total, export to:			
U.S.A.	....	196	399,700
Cuba	....	14	21,190
Canada	....	11	11,190
Colombia	....	6	9,050
Hollow glass for watches, spectacles .	1954	123	204,761
	1953	57	204,761
Of this total, export to:			
Argentina	....	3	17,850
Brazil	....	2	12,140
Glassware and laboratories, hygienic and pharmaceutical purposes	1954	869	2,477,000
	1953	685	1,894,237
Of this total, export to:			
U.S.A.	....	21	166,666
Brazil	....	22	88,880
Mexico	....	23	55,200
Chile	....	10	41,190
Uruguay	....	14	36,430
Cuba	....	19	35,710
Peru	....	18	29,500
Venezuela	....	14	28,570
Canada	....	6	21,660
Colombia	....	6	18,570
Optical glass, including glasses for spectacles	1954	196	811,191
	1953	175	1,020,238
Of this total, export to:			
U.S.A.	....	15	124,050
Argentina	....	15	41,760
Glass petty goods, glass eyes for animals	1954	1,823	8,468,330
	1953	1,398	7,226,190
Of this total, export to:			
U.S.A.	....	955	5,000,000
Canada	....	43	240,000
Cuba	....	8	45,710
Peru	....	4	27,380
Mexico	....	3	26,880
Brazil	....	7	25,470
Colombia	....	5	23,810
Venezuela	....	3	19,520
Uruguay	....	5	19,020
Other glassware, glass lamps	1954	268	215,950
	1953	233	368,571
Of this total, export to:			
Mexico	....	1	3,330

Indies (Bermuda, Bahamas, Jamaica) with the same quota and Brazil, Colombia and Venezuela with 1-2% (Table 5). In both groups (Glass and Glassware combined) export to the U.S.A. increased from $8.85 million in 1952 to $10.77 million in 1954 (i.e. 22%).

TABLE 4

Export of the Federal Republic to:

Glass	Year	Tons	Dollars
U.S.A.	1954	12,885	2,036,700
	1953	9,785	2,051,904
Canada	1954	4,407	664,700
	1953	3,156	448,095
Costa Rica	1954	171	23,600
	1953	63	8,333
Cuba	1954	402	95,500
	1953	469	124,523
Dominic Rep.	1954	150	32,700
	1953	187	34,523
Guatemala	1954	95	17,140
	1953	61	11,190
Haiti	1954	136	20,400
	1953	83	10,713
Republic of Honduras	1954	13	2,850
	1953	14	3,333
Mexico	1954	24	12,600
	1953	12	15,000
Nicaragua	1954	38	6,190
	1953	22	3,333
Republic of Panama	1954	79	25,000
	1953	30	7,857
El Salvador	1954	228	32,850
	1953	114	20,000
Br. West Indies (Bermuda, Bahamas, Jamaica)	1954	277	31,660
	1953	43	4,285
Netherlands Antilles	1954	9	2,140
	1953	5	3,095
Argentina	1954	284	130,710
	1953	733	323,333
Bolivia	1954	10	3,570
	1953	48	8,571
Brazil	1954	512	196,190
	1953	156	56,666
Chile	1954	17	5,110
	1953	44	13,571
Colombia	1954	2,162	325,480
	1953	1,182	180,238
Ecuador	1954	123	21,660
	1953	172	16,904
Peru	1954	284	57,380
	1953	975	146,428
Uruguay	1954	250	55,710
	1953	158	28,095
Venezuela	1954	1,660	293,330
	1953	820	142,142

TABLE 5

Export of the Federal Republic to:

Glassware	Year	Tons	Dollars
U.S.A.	1954	2,461	8,744,050
	1953	1,977	7,845,238
Canada	1954	422	701,430
	1953	3,156	448,095
Costa Rica	1954	305	75,710
	1953	163	47,380
Cuba	1954	133	237,400
	1953	59	187,857
Dominic Rep.	1954	462	90,240
	1953	230	50,952
Guatemala	1954	53	89,140
	1953	27	60,476
Haiti	1954	320	51,900
	1953	83	10,713
Honduras	1954	27	19,040
	1953	68	24,285
Mexico	1954	100	337,620
	1953	102	122,142
Nicaragua	1954	293	57,140
	1953	86	27,619
Republic of Panama	1954	98	41,190
	1953	99	29,285
El Salvador	1954	53	71,430
	1953	32	52,619
Br. West Indies (Bermuda, Bahamas, Jamaica	1954	2,136	341,700
	1953	498	135,476
Netherlands Antilles	1954	5	13,700
	1953	6	14,047
Puerto Rico	1954	2	8,090
	1953	2	6,904
Argentina	1954	5	12,140
	1953	11	41,904
Bolivia	1954	11	15,470
	1953	15	33,333
Brazil	1954	150	373,810
	1953	49	154,761
Chile	1954	16	78,090
	1953	16	99,761
Colombia	1954	501	323,330
	1953	134	293,809
Ecuador	1954	158	115,730
	1953	80	76,666
Paraguay	1954	12	13,090
	1953	28	36,428
Peru	1954	73	182,370
	1953	73	187,619
Uruguay	1954	43	117,370
	1953	18	60,238
Venezuela	1954	1,178	522,370
	1953	685	429,523

• N. J. Kreidl, Chemical Research Director, Bausch & Lomb Optical Company, represented the United States' glass technologists, organized in the American Ceramic Society, at the Wurzburg meeting of the International Commission on Glass, June 16 through 18. Members of the Commission then joined the open Symposium on Glass Fining being held in Paris, June 21 through 23.

Recent Translations of Russian Papers of Interest to The Glass Industry

Analysis of Gas Bubbles in Glass

V. T. Slavyanskii and E. N. Krestnikova report in *Steklo i Keramika* (*Glass and Ceramics*) **10,** No. 11, p. 11 (1953), on a method of analysis of the gas present in the bubbles smaller than 0.2 mm. (= 0.008″).

The first step is the preparation of a specimen containing one bubble only. This operation is rather tedious, if a bubble in solid glass must be analyzed. A piece of glass is ground and polished until it is about 1 mm. thick and then the edges are broken away to afford a leaflet of about 2 mm. in diameter. When bubbles in a glass melt are analyzed, a small blob is blown out in a bulb or extended in a filament, both about 1 mm. thick. A little piece of the bulb or the filament containing the bubble serves as the specimen.

A special study was made of whether isolation of single bubbles is or is not necessary. If the chemical composition of many neighboring bubbles is identical, the gas from all these bubbles could be combined and then analyzed in a simpler manner than that described below. However, Slavyanskii and Krestnikova found that each bubble in a piece of glass had its own composition and, consequently, had to be analyzed separately.

The second step is the liberation of the gas confined in a glass sample. For this, the microscope attachment shown in the left hand part of Fig. 1 is employed. It consists of a plane-convex lens whose plane face is at the top, horizontal, and fixed in the upper bar seen in Fig. 1, and a plane-convex lens attached to the lower bar and having the plane face turned downward. The glass fragment containing the bubble is wetted with glycerol and placed between the two curved faces of the lenses. When the screw (and another screw situated left of the microscope tubulus and invisible on the figure) is moved, the lenses come together and crash the fragment. The bubble rises in the glycerol drop, and its diameter is measured at a magnification of the microscope between 80 and 100. Thus the total gas amount is determined.

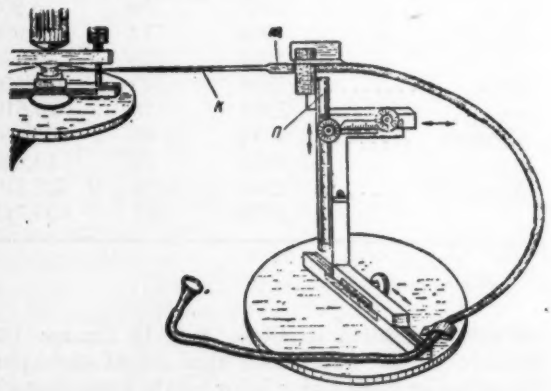


Fig. 1. The micromanipulator.

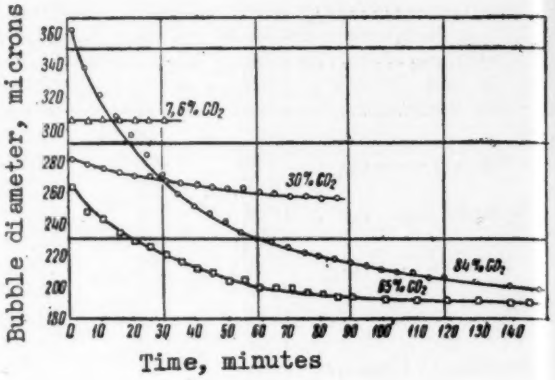


Fig. 2.

In the third step, the gas bubble is sucked into capillary k of the micromanipulator and transferred into, first, a solution of 4 g. potassium hydroxide in 10 ml. glycerol, and then an alkaline solution of pyrogallic acid. The decrease of the bubble diameter in the first solution is a measure of the carbon dioxide content of the gas, and the diameter decrease in the second solution is a measure of the oxygen amount. The gas which is not absorbed by either solution may be considered to be nitrogen. In the tests conducted by Slavyanskii and Krestnikova, its amount was not decreased either by treatment with an ammonia solution of cuprous chloride or by contact with a palladium sol; thus, the gas contained no carbon monoxide and no hydrogen.

An important error may be committed if the dissolution of the gas in glycerol is neglected. This dissolution may be noticeable within a few minutes. Fig. 2 shows that

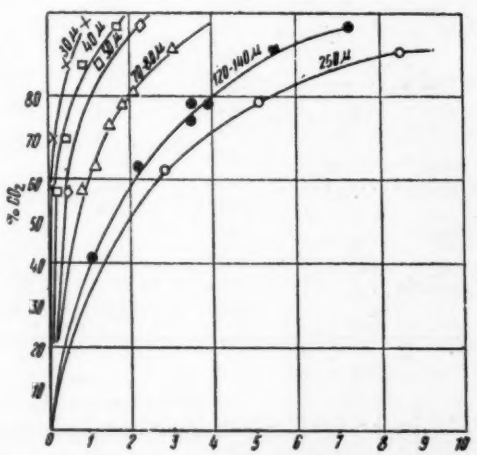


Fig. 3. Rate of decrease of the bubble diameter, microns per minute.

the diameter (plotted along the ordinate) of bubbles kept in pure glycerol decreases in time (plotted along the abscissa) if the gas contains 30% or more CO_2. The rate of decrease of the bubble diameter is greater the greater the carbon dioxide content and also the greater the initial diameter. As a matter of fact, this correlation is so well reproducible that the CO_2 percentage in the gas can be estimated within $\pm$ 8% from the above rate. Fig. 3 can be employed for this estimation. In it, the CO_2 percentage is plotted along the ordinate and the rate of decrease (microns per minute) along the abscissa. The numbers at the curves mean the initial diameters. E.g., a bubble of 250 microns (250 μ) containing 62% CO_2 contracts in glycerol at the rate of almost 3 microns/minute.

The gases in a borosilicate glass contained 21-100% CO_2 and 0-79% O_2.

Pegmatites and Alaskites as Raw Materials for Glass Manufacture

E. P. Ozhigov, in *Steklo i Keramika* (*Glass and Ceramics*) 10, No. 12, p. 14 (1953), describes the utilization of some silicates of the Siberian Pacific Coast for glass manufacture. The advantage of these silicates, as compared with sand, is that they contain alkali oxides. Thus, less soda ash is needed. Soda ash is not produced at the Pacific Coast and must be hauled from far away.

The chemical composition of the rocks tested was:

	Pegmatites	Alaskites
SiO_2	75.70-76.81	74.64-76.68
Al_2O_3	15.50-15.90	14.35-15.60
Fe_2O_3	0.20- 0.44	0.21- 0.35
FeO	0.05	———
CaO	0.72	0.30- 0.60
MgO	0.19	0.47- 0.61
$Na_2O + K_2O$	5.80- 5.84	5.43- 7.74
Loss on heating	0.58- 1.16	0.48- 0.51

Alaskites were studied more thoroughly than the other rocks. Alaskite (100 parts) ground to the particle size of 0.2-0.6 mm. was mixed with 20 parts slacked lime, 20 parts sodium carbonate, 19 parts sodium sulfate and 18 parts coal. The batch was heated in a crucible for 20 hours at 1350°C. The resulting glass had the composition:

SiO_2 62.48, Al_2O_3 10.37, Fe_2O_3 0.32,
CaO 8.35, MgO 0.46, alkali 16.8%.

It had a greenish tint but was easily workable and could be used for making bottles, etc.

For the experiments, samples of sheet glass, 70 mm in diameter, were used. They were rotated 115 times/min. whence the peripheral speed was 0.43 meter per sec. The cast iron grinder had diameter of 80 mm and exerted on the glass sample a pressure of 49 gram-weights per sq. cm. (equal to 0.69 psi). A suspension of the abrasive with density 1.22 gram/cc. was fed to the grinder, 500 ml. being used for each sample.

The abrasive employed had the distribution of particle sizes (1 micron = 0.0001 cm. = 0.00004 inch) shown in Table 1. The figures in the body of the table are the percentages of the powder weight belonging to each fraction characterized in the heading of each column; thus, 0.2 g. in 100 g. of sand No. 140 had particle diameters above 124 microns.

After grinding for 20 minutes, the glass samples were weighed and the thickness of the removed layer was calculated from the loss in weight. This thickness is listed in Table 2 in columns 3 and 4, while column 2 shows the upper diameter limit of the main fraction of the powder.

It is seen that corundum works more rapidly than sand. On the other hand, sand disrupts the glass surface less than corundum does. This is illustrated in Table 3.

The authors believe that the gain in the time needed for subsequent polishing (due to the fact that a thinner layer must be removed after grinding with glass than after grinding with corundum) will offset the loss in time due to the lesser efficiency of sand. Also, this efficiency can be increased by employing a higher pressure during grinding.

TABLE 1
DISTRIBUTION OF PARTICLE SIZES

Grain diameter in microns:	>124	124-104	104-88	88-74	74-43	<43
Sand No. 140	0.2	0.4	59.0	32.4	7.0	–
No. 170	–	0.2	1.0	56.0	42.2	0.5
No. 200	–	–	–	0.5	95.0	4.2
Electrocorundum						
No. 140	–	1.0	59.5	35.0	4.0	–
No. 170	–	–	1.0	65.3	33.2	–
No. 200	–	–	0.1	4.0	89.5	5.5

Grain diameter in microns:	52-42	42-28	28-20	20-14	14-10	10-7	7-3
Sand M-28	0.6	28.6	62.7	6.9	0.9	0.1	–
M-20	–	1.2	15.8	59.6	16.3	7.0	–
M-14	–	–	1.1	14.5	62.8	19.4	2.0
Electrocorundum							
M-28	–	9.0	72.5	15.7	2.3	0.8	–
M-20	–	–	23.5	65.1	9.2	2.1	–
M-14	–	–	1.9	20.6	63.6	16.7	1.7
M-10	–	–	–	2.0	17.4	73.5	7.0

TABLE 2
THICKNESS OF THE REMOVED LAYER, IN MICRONS

Abrasive code	Particle size in microns	Electrocorundum	Sand
No. 140	104	184	100
No. 170	88	178	95
No. 200	74	157	84
M-28	28	76	42
M-20	20	66	28
M-14	14	38	14
M-10	10	28	–

TABLE 3
MAXIMUM DEPTH OF INDENTATIONS IN MICRONS

Abrasive code	Particle size in microns	Electrocorundum	Sand
No. 140	104	20	15
No. 170	88	15	13
No. 200	74	12	11
M-28	28	6.4	5.5
M-20	20	4.9	3.5
M-14	14	4.4	2.5
M-10	10	3.5	–

Drilling of Glass

A study of the most favorable shape of drills for glass drilling was made by V. A. Fedotov, *Steklo i Keramika* (*Glass and Ceramics*) **10,** No. 11, p. 18 (1953).

Fig. 1 shows the effect which terminates the through-drilling of a glass plate. When the cylindrical part of the drill is still h cm. distant from the lower plate face, a circular crack occurs, and a glass annulus falls out. The angle between the walls of the hole thus formed is $\psi°$, and the largest diameter of the hole is D cm. The drilling operation is more successful the smaller h and D are, i.e., the smaller the deviation of the hole from pure cylindrical shape.

In Fedotov's experiments, the relation between h and D on one hand and the cone angle $2\varphi°$ of the drill was

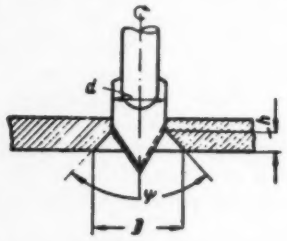


Fig. 1.

determined. Window glass plates, 6x100x200mm., were used, and 8 holes were made in each plate by a drill under a kerosene layer. The drills rotated 662 times a minute, the advance per rotation was 0.03mm, and the drill diameter was 6mm. (see d in Fig. 1). The cone angles 2φ were 45°, 60°, 75°, 90°, 100°, 120°, and 135° for the different drills.

Fig. 2 summarizes the experimental data. The cone angles are plotted along the abscissa, and the greatest h and D among the eight in each set of holes are ordinates (both in mm); curve 1 refers to D and curve 2 to h. It is seen that acute cones yield smaller h and D and are more favorable than more obtuse cones. The greatest deterioration occurs when 2φ increases from 90° to 100°.

In another series of experiments, the downward load on the drill was kept constant, and the time required to

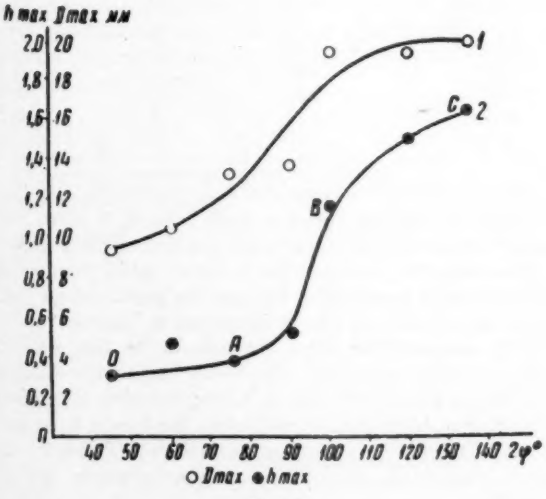


Fig. 2.

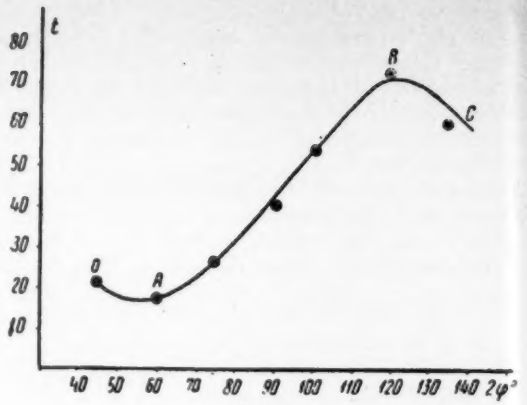


Fig. 3.

drill through a 6 mm plate was measured. The results are shown in Fig. 3. Again, 2φ is plotted along the abscissa. The ordinate represents the time required, in seconds. The shortest time was observed at $2\varphi = 60°$, but the time at $2\varphi = 45°$, was not much greater. As $2\varphi = 45°$ proved to be better in the first test, see Fig. 1, this cone angle is recommended.

Kerosene was a much better "cutting fluid" than water. The time required to drill a plate through was 3 times as long under water as under kerosene when the drill was fresh, while a drill used for the third time under water required 6 times as much time as a drill used for the third time under kerosene. This shows that the wear under water is greater than the wear under kerosene. The layer of kerosene above the plate should be at least 10 mm. deep. Absence of vibrations is essential.

The Mechanism of Formation of "Open Bubbles"

Are "open bubbles" in sheet glass, i.e., elongated depression resulting from bursting of surface bubbles, just bubbles which happened to lie in the surface layer or do

TABLE I

Day of a month	Interior bubbles per sq. meter	Open bubbles per sq. meter
1	132	16
2	132	6
6	140	15
7	105	18
8	90	15
9	88	14
11	75	7
12	130	12
13	35	8
14	58	10
15	28	8
16	83	6
20	72	10
21	69	5
22	128	10
23	105	5
25	78	8
26	58	6
28	160	15
29	170	16
30	205	15

they have a different origin? This question was considered by V. V. Pollyak in *Steklo i Keramika* (*Glass and Ceramics*) **10,** No. 12, p. 12 (1953), and the second alternative was preferred.

A clear evidence for the second view is afforded by a comparison of the numbers of internal and superficial bubbles in different glasses. If the open bubbles had an origin identical with that of internal bubbles, the ratio of the former to the latter would be approximately constant if different glasses are compared. Table I lists the number of bubbles visible in 1 sq. meter of sheet glass produced on consecutive days of a month. It is seen that the frequency of open bubbles is independent of that of internal air bells.

Open bubbles form when foreign matter contaminating the sheet surface liberates a gas. Soot and iron oxides are the main contaminants of the glass surface. Soot gives rise to carbon dioxide bubbles, while higher iron oxides dissociate at high temperatures and evolve oxygen. Soot may be present on the debiteuse from its annealing or may have its origin in the furnace fuel. Iron oxides reach glass surface from the refractory walls or the debiteuse.

Electrical Conductivity of Solid Glasses

V. I. Shelyubskii reports, in *Steklo i Keramika* (*Glass and Ceramics*) **10,** No. 9, p. 13 (1953), on his measurements of the resistivity of various glasses between 150° and 500°C. Unfortunately, the composition and the method of manufacturing the glasses are not mentioned. To obtain reliable results, the glass cylinders used for measurement must have the basis ends silvered or coated with graphite, and the current must traverse them from basis to basis. Some scientists determined the resistance between two metal wires fused into glass, but this procedure is apt to give erroneous results.

Quartz Sand for Grinding Sheet Glass

Substitution of sand for the more expensive corundum in glass grinding was advocated by Yu A. Brodskii and Z. M. Zinkova in *Steklo i Keramika* (*Glass and Ceramics*) **10,** No. 9, p. 9 (1953).

Viscosity of Industrial Glasses

M. V. Okhotin and R. I. Tsoi published in *Steklo i Keramika* (*Glass and Ceramics*) **10,** No. 6, p. 11 (1953) another installment of their work on the viscosity of glasses. The method used was, as before, that of extension of a glass rod. Viscosity η was calculated from the equation $\eta = \frac{Pl_0l_1Zg}{3V\Delta l}$, in which P is the mass extending the rod, l_0 and l_1 the initial and the final lengths of the rod, g acceleration due to gravity, V the volume of the rod, and Δl the extension of the rod during time interval Z.

In the following table, the glass composition is shown in the first line, the temperature (°C) of the measurements in the second, and the $\log_{10}$ of the corresponding viscosity (in g./cm.sec) in the third line. The possible error of the η was 4 to 8%.

No. 7	SiO_2 71.68, Na_2O 16.26, CaO 7.57, MgO 3.15, Al_2O_3 1.35							
	534°	553°	570°	591°	631°	669°		
	13.13	12.19	11.41	10.61	9.4	8.41		
No. 8	SiO_2 74.26, Na_2O 16.49, CaO 4.9, MgO 2.94, Al_2O_3 1.02							
	529°	549°	591°	632°	670°			
	12.86	11.96	10.36	9.15	8.22			
No. 12	SiO_2 70.36, Na_2O 16.24, CaO 9.27, MgO 3.02, Al_2O_3 1.23							
	529°	550°	591°	632°	670°			
	13.4	12.42	10.71	9.42	8.37			
No. 13	SiO_2 72.53, Na_2O 16.5, CaO 5.24, MgO 2.98, Al_2O_3 2.96							
	544°	591°	627°	664°	670°			
	12.54	10.72	9.62	8.62	8.48			
No. 18	SiO_2 70.57, Na_2O 16.15, CaO 7.22, MgO 3.02, Al_2O_3 3.11							
	549°	570°	591°	612°	632°	651°	668°	
	12.96	11.87	11.00	10.19	9.62	9.06	8.64	
No. 26	SiO_2 68.68, Na_2O 16.19, CaO 7.15, MgO 3.01, Al_2O_3 5.09							
	555°	591°	632°	670°				
	13.02	11.3	9.79	8.74				
No. 30	SiO_2 69, Na_2O 16, CaO 9, MgO 3, Al_2O_3 3 (approx.)							
	549°	570°	591°	632°	670°			
	12.85	11.66	10.84	9.51	8.43			
No. 31	SiO_2 67, Na_2O 15.94, CaO 8.95, MgO 3.06, Al_2O_3 5.06							
	554°	570°	584°	591°	632°	670°		
	12.85	11.95	11.31	10.98	9.66	8.64		
No. 32	SiO_2 71, Na_2O 16, CaO 5, MgO 3, Al_2O_3 5 (approx.)							
	549°	570°	612°	632°	670°			
	12.57	11.59	10.16	9.62	8.6			
No. 38	SiO_2 74.06, Na_2O 14.67, CaO 7.22, MgO 3.01, Al_2O_3 1.04							
	549°	570°	591°	612°	632°	651°	670°	688°
	12.73	11.74	10.87	10.22	9.69	9.17	8.64	8.15
No. 39	SiO_2 72, Na_2O 15, CaO 7, MgO 3, Al_2O_3 3 (approx.)							
	549°	570°	591°	632°	651°	670°	709°	
	12.86	12.00	11.19	9.86	9.35	8.84	8.02	
No. 40	SiO_2 70, Na_2O 15, CaO 7, MgO 3, Al_2O_3 5 (approx.)							
	549°	570°	591°	612°	632°	651°	688°	
	13.27	12.24	11.36	10.60	9.98	9.52	8.64	
No. 41	SiO_2 71.93, Na_2O 14.67, CaO 9.14, MgO 2.93, Al_2O_3 1.02							
	546°	549°	570°	591°	632°	670°		
	13.01	12.80	11.79	10.96	9.64	8.52		
No. 42	SiO_2 70, Na_2O 15, CaO 9, MgO 3, Al_2O_3 3 (approx.)							
	549°	570°	591°	612°	632°	651°	688°	
	13.2	12.08	11.19	10.44	9.82	9.23	8.27	
No. 43	SiO_2 68, Na_2O 15, CaO 9, MgO 3, Al_2O_3 5 (approx.)							
	554°	570°	591°	612°	632°	651°	688°	
	13.2	12.4	11.46	10.69	10.01	9.44	8.46	
No. 44	SiO_2 76, Na_2O 15, CaO 5, MgO 3, Al_2O_3 1 (approx.)							
	538°	549°	570°	591°	632°	651°	688°	
	12.84	12.25	11.26	10.48	9.32	8.9	8.11	
No. 45	SiO_2 74, Na_2O 15, CaO 5, MgO 3, Al_2O_3 3 (approx.)							
	538°	554°	570°	591°	612°	632°	651°	688°
	13.21	12.37	11.54	10.69	10.14	9.57	9.16	8.24
No. 46	SiO_2 72, Na_2O 15, CaO 5, MgO 3 Al_2O_3 5 (approx.)							
	549°	570°	591°	612°	632°	670°	688°	
	13.10	12.02	11.00	10.36	9.84	8.85	8.52	
No. 54	SiO_2 73.85, Na_2O 15.84, CaO 8.16, MgO 1.09, Al_2O_3 1.11							
	553°	572°	591°	610°	629°	665°		
	12.2	11.33	10.56	9.97	9.41	8.41		
No. 65	SiO_2 71.8, Na_2O 15.06, CaO 10.37, MgO 0.97, Al_2O_3 1.54							
	553°	572°	591°	610°	629°	665°		
	12.45	11.45	10.55	9.96	9.43	8.40		
No. 71	SiO_2 68.02, Na_2O 15.6, CaO 10.18, MgO 3.15, Al_2O_3 4.28(?)							
	553°	576°	591°	610°	629°	665°		
	12.86	11.91	11.28	10.59	9.81	8.79		
No. 43-A	SiO_2 71.94, Na_2O 15.66, CaO 6.24, MgO 1.12, Al_2O_3 4.08							
	538°	553°	572°	591°	610°	629°	665°	
	12.9	12.17	11.45	10.69	10.1	9.63	8.63	
OSZ	SiO_2 72.37, Na_2O 16.43, CaO 6.17, MgO 3.58, Al_2O_3 0.36							
	529°	553°	572°	591°	610°	629°	665°	
	13.05	11.9	11.02	10.4	9.73	9.31	8.36	

• American Potash & Chemical Corporation received the Lammot du Pont Safety Plaque award at the annual meeting of the Manufacturing Chemists' Association. The award is made to chemical companies showing the greatest improvement in plant safety over a five-year period. This is the ninth safety award the company has won this year covering safety records made by it and its various divisions.

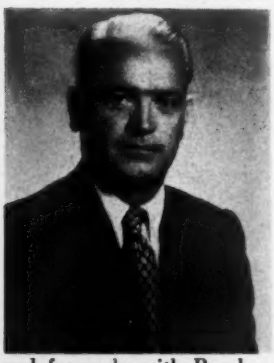
Brockway Glass President Glenn A. Mengle breaks ground for new Freehold, N. J., plant. Also present were, left to right, R. L. Warren, Jr., F. B. Hess, Jean Masbach, A. M. Saperston, D. L. Sheesley.

GROUND BROKEN FOR BROCKWAY'S NEW PLANT

The Brockway Glass Company broke ground on June 1 at Freehold, New Jersey, for its proposed new glass container plant. Present for the ground-breaking ceremony were President Glenn A. Mengle, and other members of the Board of Directors, Vice President F. B. Hess, Vice President R. L. Warren, Jr., Secretary A. M. Saperston, Treasurer D. L. Sheesley and Jean Masbach.

Contract for construction of the 150,000 square foot plant was awarded to Nicholson Company, Inc. of New York City. Plans are for the new plant to be in operation by the spring of 1956.

GLENSHAW NAMES GENERAL SALES MANAGER



George W. Meyer, President of the Glenshaw Glass Company, Inc., has announced the appointment of A. Lincoln Key to the post of General Sales Manager for that company.

Mr. Key, who served during the war as a consultant to the War Production Board for the glass container industry and formerly with Brockway Glass Company, brings to Glenshaw Glass many years of experience in the glass container field.

PYREX FEATURES PATTERN

The first Pyrexware line ever to be identified by a pattern name is being shown at the 1955 National Housewares Show in Atlantic City. The new line is "Desert Dawn" bakingware, a modern speckled pattern available in two colors.

Called by Corning Glass Works, "a new approach to color in bakingware," the Desert Dawn line is now available colored either in Desert Pink or Desert Yellow. As the name implies, the pattern is inspired by dawn on the American desert.

L-O-F CONTINUES RESEARCH EXPANSION

Following closely on the appointment of Harold M. Alexander as General Manager of Research and Development and Dr. Joseph D. Ryan as Director of Research, Libbey-Owens-Ford Glass Company has announced several additional promotions and new section assignments.

Dr. Roy W. Wampler, who joined L-O-F as a research chemist in 1929 and who lately has been in charge of products research, has been promoted to Associate Director of Research and will work closely with Dr. Ryan in the company's broadened research activities. Much of Dr. Wampler's work with L-O-F has been in the field of multiple glazing units leading to the perfection of Thermopane and improvements in its manufacture.

R. A. Gaiser continues as Assistant Director of Research in charge of the growing field of glass films research. Joining the firm in 1942, he has supervised the research program which resulted in Electrapane, a glass with a transparent electrical conducting film.

Dr. Howard R. Swift is the new chief of the glass technology section. Joining Libbey-Owens-Ford directly from University of Illinois in 1945, Dr. Swift became a member of the glass technology research staff. He won the Frank Forrest Award in 1948.

LEO SHARTSIS RECEIVES N.B.S. AWARD

Leo Shartsis, of the National Bureau of Standards, has received the Silver Medal for Meritorious Service from the Department of Commerce. This award was presented in recognition of his original and outstanding contributions to improve scientific understanding of the structure and constitution of glasses.

Mr. Shartsis, a physical chemist in the Glass Section of the Mineral Products Division of the Bureau, is engaged in developing apparatus and techniques for studying the properties of simple glass forming systems. Though the art of glassmaking has been practiced for thousands of years, the exact structure of glass is still not completely understood. The study of the properties of materials is one of the basic areas of research carried out at the Bureau. The research of Mr. Shartsis on the physical properties of glass in the molten, transformation and solid states has contributed to the better understanding of the structure of glass. Mr. Shartsis is co-author of some 15 publications, and co-inventer of Methods of Reducing the Concentration of Silica in Sodium Aluminate Solutions, Patent Number 2,519,362.

WEST END DISCOVERS LIME ROCK DEPOSIT

West End Chemical Company has announced the discovery and acquisition of a new, exceptionally pure, lime rock deposit in the Argus Range, Inyo County, California, just north of their present plant location in Westend, California.

Company officials are anticipating transferral of their present quarry operations to the new site in the immediate future. Under consideration is the installation of a rotary lime kiln using natural gas as fuel. Top capacity of the new kiln will be 170 tons of lime per day. The carbon dioxide resulting from the rotary kiln operation will be used in the carbonation process, thus eliminating the vertical lime kiln operation.

Inventions and Inventors

Annealing and Tempering

Means and Method of Hardening Glass Articles. Fig. 1. Patent No. 2,695,475. Filed October 21, 1949. Issued November 30, 1954. One sheet of drawings. Assigned to American Optical Company by Charles A. Ellis.

The principal object of the invention is to provide novel means and methods of hardening and tempering glass articles, such as lenses, whereby the cycle of heating may be automatically controlled. In order to harden or temper the lens 9, it is placed in holding jaws of the support 8, as shown in Fig. 1. The power is then turned on at the source of electrical energy 28 causing the electrical energy to energize the solenoid 23 of the third circuit whereupon the core 36 responding to the energizing will cause the support 8 and the lens 9 being carried to be raised into the heating chamber 4 and into alignment with the preheating element 5. The glass article or lens 9 is subjected to the heat generated internally of the heating chamber 4 by the pre-heating element 5.

When the desired amount of heat is generated through induction in the article 9 and the contact elements 31 and 32 engage each other, this causes the solenoid relay 26 of the second circuit to be energized whereby the movable contact 25 will be drawn into engagement with the solenoid relay 26 against the action of the resilient means 35. This causes the movable contact 25 of the third circuit to disengage with the fixed contact 33 causing the solenoid coil 23 to be de-energized. The support 8, under the action of gravity, will then move downwardly with respect to the heating chamber 4 thereby causing the article or lens 9 to be moved into alignment with the air jets 37 and 38. This operation is purely automatic and takes place only when the article 9 has been heated to the proper temperature.

The patent contains 12 claims and 17 references were cited.

Feeding and Forming

Apparatus for Shaping Glass Sheets. Fig. 2. Patent No. 2,695,476. Filed December 5, 1950. Issued November 30, 1954. Four sheets of drawings. Assigned to Libbey-Owens-Ford Glass Company by Joseph E. Jendrisak.

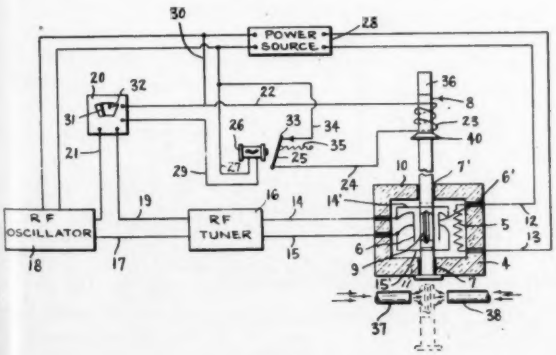


Fig. 1.

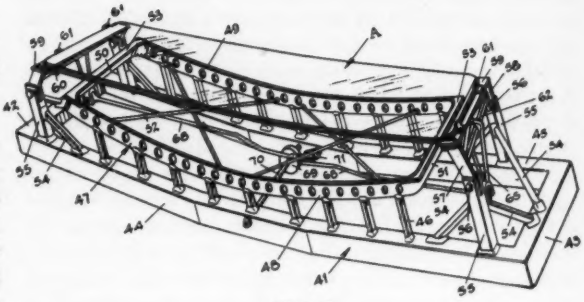


Fig. 2.

This invention relates to glass bending apparatus and more particularly to an improved type of bending mold which is provided with a skeleton or peripheral shaping surface conforming to the curvature attained by the glass sheet or plate upon completion of the bending. As the mold, with glass sheet mounted in the manner noted in Fig. 2, passes through a furnace and reaches bending temperature, the glass sheet tends to bend longitudinally of its length and simultaneously the pivoted members slowly descend downwardly and, through the locating fingers 61, exert longitudinal forces on the ends of the sheet. During the synchronized downward movement of the pivoted support members 57 and 58, that side of the glass sheet A of proposed greater curvature will be forced to traverse a longer arc than the opposite side of the sheet in order that, when the bending cycle is completed, the more severely bent side of the glass sheet will conform to the curvature of the longitudinal strip member 48 and the side of lesser curvature will conform to the opposite strip member 49.

In the formation of bends or curves of this type, it is normal for the central portion of the glass sheet A to contact the central portions or regions of greater curvature of the longitudinal strip members 48 and 49 first, followed by conformity of the remaining areas of the sheet outwardly to the ends upon the desired portions of the longitudinal members 48 and 49 so that, when the bending operation is completed, the guide means or plates 53 will be finally contacted by the movable guiding members 59 and the ends of the glass sheet A deposited upon the guide means. However, inasmuch as there is provided synchronizing means and guide means which are contoured extensions of the shaping surface, all marginal areas of the glass sheet contact and settle upon their respective portions of the shaping surface without undesirable sliding and consequent marring of the sheet or plate thereon.

The patent contains nine claims and the following references were cited: 2,003,383, Miller, June 4, 1935; 2,452,488, Paddock et al., Oct. 26, 1948; and 2,554,572, Jendrisak, May 29, 1951.

Furnaces

Electric Glass Melting Furnace. Fig. 3. Patent No. 2,697,125. Filed August 18, 1953. Issued December 14,

1954. One sheet of drawings. Assigned to General Electric Company by Ronald W. Douglas.

This invention relates to electric glass melting furnaces of the type, usually referred to as "tank" furnaces, comprising a chamber adapted to contain the glass forming materials during the melting process, two or more apertures being provided in the walls of the chamber for the insertion of immersion electrodes. The electrodes are not permanently fixed in the operating position, but are insertable into and removable from the furnace as required, and the object of this invention is to provide an arrangement which facilitates the insertion and removal of the electrodes while the tank is full of molten glass.

In operation, as shown in Fig. 3, the molybdenum electrode is inserted into an aperture in a wall of the glass melting furnace so far that the plate 25 rests against the outside of the furnace wall, the rods 13 and the block 11 being immersed in the molten glass, while the steel parts of the shank are entirely outside the molten glass. The part within the aperture is surrounded by solid glass when cooling water is caused to flow through the hollow plate 25 and the jacket 24. In addition to facilitating the insertion and removal of the electrodes, the inclined apertures confer the further advantage that the electrodes inserted are also inclined, and therefore the surface area of the electrodes presented to the glass in the direction of current flow between each pair of electrodes is greater than is the case with electrodes of a similar form, but disposed horizontally through the furnace walls as has been the usual practice. Hence, the supply of current to the molten glass is greater and the heating of the glass is accordingly more effective, resulting in the production of better quality glass.

The patent contains two claims and the following references were cited: 742,419, Harmet, Oct. 27, 1903; 867,948, Colburn et al., Oct. 15, 1907; 1,044,957, Washburn, Nov. 19, 1912; 2,131,599, Shrum, Sept. 27, 1938; 2,209,515, Ehman et al., July 30, 1940; 4,031, Great Britain, Feb. 20, 1903; and 99,936, Sweden, Oct. 1, 1940.

Glass Wool and Fiber

Method of Making Mat of Glass Fibers. Fig. 4. Patent No. 2,697,056. Filed February 1, 1952. Issued December 14, 1954. One sheet of drawings. Assigned to Vibradamp Corporation by Ralph E. Schwartz.

A novel method of forming glass fiber mats is shown in Fig. 4. Molten glass is forced through the electrically heated platinum dies 14 by gravity, and it is shaped by the dies 14 into one or more primary glass fibers 16, the number of primary glass fibers 16 in each batch being determined by the number of dies 14. These primary glass fibers 16 are then pulled downwardly by feed rollers 18 and 20. The primary fibers are fed into position in front of a hot gas jet 22 which blows ignited gas substantially horizontally at the primary fibers 16 as these fibers are moved in front of it by rollers 18 and 20.

The combination of air and burning gas from jets 24, 26 and 22, respectively, produces a high-speed movement of hot gaseous matter which strikes the primary glass fibers 16 and causes each of the primary fibers 16 to be split into a large number of secondary fibers 28, each of which has a much smaller diameter than the diameter of the primary fibers 16. The temperature of the molten glass 12 in the vessel 10, the temperature of the heated dies 14, the speed of rotation of the rollers 18 and 20, the rate of flow of the gas out of the jets 22, the rate of flow of the air out of the air jets 24 and 26, and the kind of glass that is used are all accurately controlled and kept at substantially the same values during the formation of each mat. By thus accurately controlling the suction through the forming belt 42 and the amount and direction of the air that is blown from air jets 24 and 26, one can produce fiber glass mats that are considerably thicker than the ordinary mat of glass fibers. Also the mats are

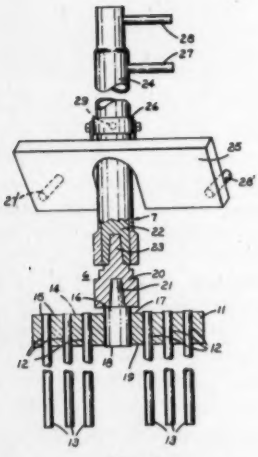


Fig. 3.

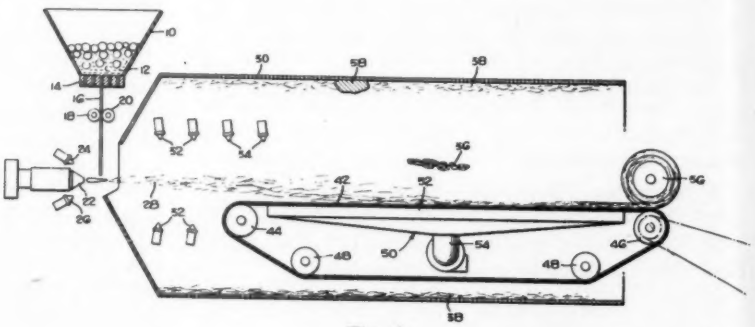


Fig. 4.

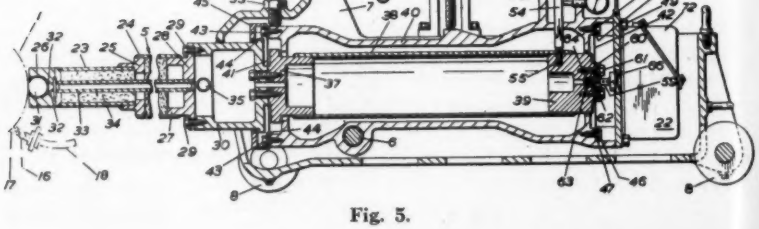


Fig. 5.

substantially uniform throughout in thickness and in density.

The patent contains 2 claims and 12 references were cited.

Sheet and Plate Glass

Apparatus for Detecting Bowing in Rotating Cylinders or Rolls and for Straightening Rotating Cylinders or Rolls by Controlling the Bowing When Detected. Fig. 5. Patent No. 2,696,698. Filed September 1, 1951. Issued December 14, 1954. Three sheets of drawings. Assigned to Pilkington Brothers Limited by Richard Davison and William A. Lightfoot.

This invention relates to a method and apparatus for controlling bowing in rotating cylinders or rolls in continuous plate glass processes. As shown in Fig. 5, the roller 31 of the sensing head 26 runs on the surface of the casting cylinder 1 as the latter rotates and immediately a convexity commences, it is sensed by the sensing roller 31. The latter is then displaced from the casting cylinder 1 and moves the sensing member 5 axially with respect to the housing, and as a consequence the input member 59 is caused to operate a micro-switch to energize the valve 19 (not shown). This permits the passage of a stream of cooling air through the conduit 16 on to the cylinder 1 when the bowed portion reaches the trajectory of the stream. When the bowed portion of the cylinder 1 passes beyond the stream, a micro-switch is released to de-energize valve 19 and so shut off the air supply. A stream of cooling air is thus projected on to the convex bowed portion of the cylinder 1 each time the cylinder rotates and the eccentricity of the cylinder is indicated on the gauge 57. The hand wheel 15 can be rotated by the operator to adjust the position of the sensing device with respect to the cylinder 1.

The patent contains seven claims and the following references were cited: 1,954,270, Smith, Apr. 10, 1934, and 1,982,571, Clark, Nov. 27, 1934.

Method of Coating a Sheet of Polyvinyl Butyral Resin and Laminating Said Sheet Between Glass Plates. Patent No. 2,697,053. Filed April 25, 1951. Issued December 14, 1954. Two sheets of drawings (none reproduced). Assigned to E. I. du Pont de Nemours and Company by Gelu S. Stamatoff.

A method is given for producing a roughened surface on sheet materials to be used as safety glass interlayers. The following materials are used: A sheet 15 mils thick composed of 30 parts di(butoxy ethyl) adipate as plasticizer and 70 parts polyvinyl butyral resin of the following constitution: ester content calculated as polyvinyl acetate 0.5%; hydroxyl content calculated as polyvinyl alcohol 19.0%; acetal content calculated as polyvinyl butyral 80.5%. A coating solution consisting of 94.5 parts ethyl alcohol and 5.5 parts of an organic plastic composition composed of 25 parts di(butoxy ethyl) adipate as plasticizer and 75 parts polyvinyl butyral resin of the following constitution: ester content calculated as polyvinyl acetate 0.5%; hydroxyl content calculated as polyvinyl alcohol 11.5%; acetal content calculated as polyvinyl butyral 82%.

The sheet is soaked in water for four hours in order to saturate it. Excess water is removed from the surface and the sheet is coated on each side by dipping in the coating solution. The excess coating solution is removed by passing the sheet between two parallel spaced bars 20 mils apart, thus leaving on each side of the sheeting approximately a 2.5 mil coating. The coated sheeting is sprayed with water using a shower type sprayer for about ten seconds. The coated sheeting is seasoned in water for one-half hour and dried at 53° C. for two hours. The sheeting after drying was uniformly embossed on each side and was non-tacky. Sheeting coated with the same solution and seasoned but not embossed was tacky.

The surface configuration of embossed coated sheets is relatively uniform, and the invention may therefore be used not only for the production of useful effects in the manufacture of safety glass, but also in the production of useful ornamental effects.

The patent contains two claims and the following references were cited: Re.21,045, Bright, Apr. 11, 1939; 1,011,181, Galay, Dec. 12, 1911; 1,353,599, Lovell, Sept. 21, 1920; 1,674,403, Lilienfeld, June 19, 1928; 2,113,767, Paggi, Apr. 12, 1938; 2,162,678, Robertson, June 13, 1939; 2,510,966, Flanagan, June 13, 1950; and 507,138, Great Britain, June 7, 1939.

Laminated Safety Glass Structures and Method of Making the Same. Fig. 6. Patent No. 2,697,675. Filed March 21, 1951. Issued December 21, 1954. Two sheets of drawings. Assigned to Libbey-Owens-Ford Glass Company by Romey A. Gaiser.

It is the aim of this invention to provide a special type of electrically conducting laminated safety glass which will eliminate electrode failure and edge separation in the unit under the most extreme temperature conditions. The illustration is shown in Fig. 6.

After the glass sheet 11 with electrodes 13 has been filmed, and before it is laminated, there is applied over the area of the electrode, and preferably for a short distance inwardly beyond the inside edge, a separator which, in this case, is a layer of parting material 16. That is, a material which exhibits a poor bond, or practically no bond at all between itself and the bus bar material, and also little or no bond between itself and the plastic interlayer 12. There are a great many materials that are

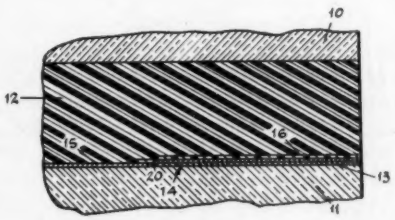


Fig. 6.

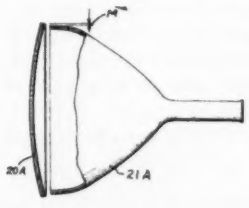


Fig. 7.

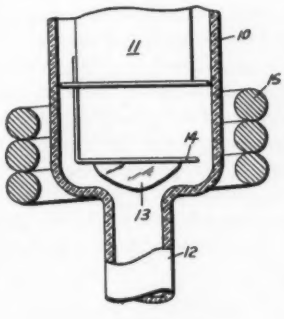


Fig. 8.

satisfactory for this purpose. For example, cellulose acetate and untreated cellulose acetate, dissolved in various solutions, also silicone oils, stearic acid, vinyl chloride resin solutions, etc. It may also be desirable to extend the layer of parting material downwardly over at least a part of the adjacent edge of the glass. After application of the parting material 16, the glass sheet 11 may be laminated with any desired number of alternate layers of glass and plastic to provide the type of laminated unit required.

The patent contains 17 claims and the following references were cited: 1,751,051, Nobbe, Mar. 18, 1930; 2,121,777, Bailey et al., June 28, 1938; 2,270,323, Land, Jan. 20, 1942; 2,303,151, Watkins, Nov. 24, 1942; 2,567,353, Ryan, Sept. 11, 1951; and 2,576,392, Downes, Nov. 27, 1951.

Tube and Cane Machines

Method of Making Glass Tube Envelopes. Fig. 7. Patent No. 2,697,311. Filed December 19, 1949. Issued December 21, 1954. Two sheets of drawings. Assigned to Polan Industries Incorporated by Lincoln M. Polan.

An object of the invention is to provide a novel glass envelope for cathode ray tubes and the like having a ground and polished window panel with substantially more undistorted viewing area than the window panel of a comparable glass envelope made according to methods prevailing heretofore.

This novel method entails the welding of a window panel blank 20A to a funnel blank 21A (refer to Fig. 7). The envelope T cannot be constructed satisfactorily unless the transverse dimension or diameter of the peripheral edge of the window panel blank exceeds the corresponding external transverse dimension or diameter of the base of the funnel blank so as to define a substantial marginal overlap M on the inner face of the panel blank. A minimum of approximately $\frac{1}{32}''$ is required on a 10″ diameter tube envelope, the maximum being about equal to the panel thickness.

The first step is to preheat these blanks in a furnace, stopping well short of their fusion temperature. Once the blanks have been preheated, the next step is to mount them in axially spaced relation upon an appropriate rotatable supporting device which is adapted to rotate them in unison about a common axis. The panel blank is heated individually first because in practically every instance it is made of thicker glass than the funnel blank for structural reasons and consequently takes more heat to bring its fusion area up to proper welding temperature. When the peripheral edge portion of the panel blank 20A has reached fusion temperature, the glass will become plastic and will tend to assume a rounded off shape due to the surface tension action. When this occurs, the panel and the funnel blanks are moved axially relative to each other and into closely spaced relation, still rotating in unison. When the foregoing has been accomplished, the stresses induced in the panel and funnel as a result of the fusion operation are distributed and equalized by rotating the newly formed envelope relative to a pair of annealing burners 30 (not shown).

The patent contains 3 claims and 14 references were cited.

Method for the Removal of Glass Strains on Automatic Sealing Machines. Patent No. 2,693,054. Filed April 21, 1952. Issued November 2, 1954. Two sheets of drawings (none reproduced). Assigned to Westinghouse Electric Corporation by Frank Reciniello.

A method is shown for the removal of glass strains from incandescent lamp bulbs on an automatic sealing machine. The method comprises sealing a tubulation and lead carrying mount to a bulb, rapidly cooling the seal below the annealing temperature to solidify the seal, raising the bulb from contact with the bulb holder, uniformly reheating the bulb to the annealing temperature while so raised, and cooling the bulb to a temperature well below the strain point of the glass of the bulb.

The patent contains one claim and the following references were cited: 1,655,140, Fagan, Jan. 3, 1928; 2,195,483, Franke, Apr. 2, 1940; 2,237,186, Malloy, Apr. 1, 1941; 2,413,960, Eisler, Jan. 7, 1947; and 2,518,924, Niles, Aug. 15, 1950.

Miscellaneous Processes

Method of Tipless Sealing of Vitreous Envelopes. Fig. 8. Patent No. 2,694,273. Filed June 20, 1951. Issued November 16, 1954. One sheet of drawings. Assigned to Raytheon Manufacturing Company by Albert B. Spyut.

This invention relates to methods of and apparatus for sealing glass envelopes, such as those for miniature and sub-miniature vacuum tubes, without leaving a tip. A lump of soft or low melting point glass 13, as shown in Fig. 8, is fastened to the under side of a bracket 14 attached to the mount 11. This lump of glass 13 may be firmly affixed on the bracket 14 by heating either the glass or the bracket, or both, and affixing the piece of glass 13 to the bracket 14. The mount 11 is then inserted in the envelope 10 in the usual manner and the assembly is subjected to the usual processing. When the stage in the processing is reached at which the envelope is to be sealed off, an inductive heating coil 15 is positioned about the envelope 10 and arranged to heat only the bracket 14. When the bracket 14 heats, it transmits its heat to the glass lump 13 which softens and falls down into the opening from the envelope 10 into the exhaust tubulation 12 to form a seal for the exhaust opening, as shown in Fig. 8.

The patent contains two claims and ten references were cited.

Method for Making Glass Paper. Fig. 9. Patent No. 2,692,220. Filed November 19, 1951. Issued October 19, 1954. Two sheets of drawings. Assigned to Glass Fibers, Inc. by D. Labino.

This invention relates to methods for producing, as a new article of manufacture, a glass paper. In Fig. 9, there is illustrated a heating and melting chamber 10 into which glass marbles are fed from a supply hopper 11. By con-

(*Continued on page* 384)

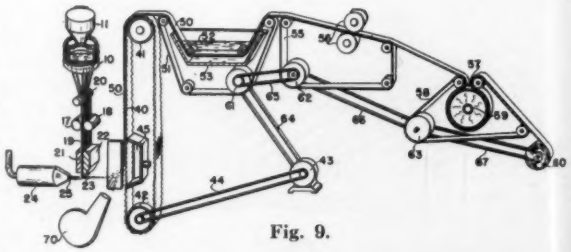


Fig. 9.

Moisture-Condensation Patterns on Glass and Crystalline Surfaces

Anyone who has carefully observed the condensation of moisture on cold surfaces, for example on frosted window panes, knows that the moisture film is particularly sensitive to the type of surface on which it condenses. When moisture condenses on glass, intricate patterns are formed and under certain conditions these patterns will follow minute irregularities on the glass surface. This indicates that the initial moisture film establishes the pattern for crystal growth as in the case of frost patterns.

Such condensation patterns, or breath figures (the breath figures are produced by gently breathing on a cold, dry surface causing a film of moisture to be condensed), have been used to study the surfaces of quartz crystals and other materials. W. C. Levengood (*Journal of the American Ceramic Society*, May 1955) reports on a method whereby the breath film was preserved long enough for a detailed study. This technique was then utilized to study the fracture patterns on the surface of glass. Various experiments on the effects of polishing, etching and other treatments on the fracture conditions were made. Included were illustrations of the Griffith fracture patterns around impact areas. Regular and etched surfaces of quartz crystals were also studied by this method. The method is best adapted to surfaces which are reasonably flat, but flat surfaces are not absolutely necessary. The studies by Levengood were made on plane surfaces.

Before examination by means of the condensation pattern, the surface of the glass was cleaned with precipitated calcium carbonate, rinsed in tap water (20°C.) and rubbed gently with a piece of clean absorbent cotton to remove the calcium carbonate. It was then given a quick rinse with distilled water. During these cleaning and handling operations, care was taken not to contaminate the surface with any foreign material.

After cleaning, the surface was wiped with a soft absorbent tissue (using a circular motion) until absolutely dry. A film of moisture was condensed on the sample by breathing gently on the surface to be studied. The surface was quickly covered by a small chamber to prevent evaporation. The sample and chamber were then placed under the microscope for observation.

The size of the minute droplets of moisture formed on the test surface is not critical. However, too heavy a film can completely cover the surface and obscure the details desired for study and droplets too small will quickly evaporate. The diameter of the droplets found to give optimum conditions for observation was in the range 0.03 to 0.06 mm. This size range is easily obtained and can be consistently reproduced after several trial runs.

In the breath figure studies, fractures and scratches on the glass surface were always observed in the photomicrographs as light, contrasting sharp lines. Small cellular areas with irregular outlines are the droplets of water and short wavy lines are their interfaces. These interfacial lines do not necessarily follow the surface irregularities. However, when several of the droplet cells collect along the edge of a fracture, it is outlined as a continuous sharp line. These fractures vary in number and direction, depending on the type of glass and on the condition of the surface. The fracture widths are generally beyond the resolution of the microscope and so in some cases are probably in the range of the so-called Griffith flaws. They may also vary in number or length owing to the stress in the glass, as well as to other factors governing surface conditions. For example, ordinary sheet glass with a fire-smooth surface has far fewer fractures than a polished surface.

Various mechanical treatments can produce interesting fracture patterns. The condensation pattern of an impacted area of a sample of plate glass showed that in areas where the impact force is the least, i.e., away from the heavily fractured area, and no fractures are observed under the microscope, the typical circular fractures may still be seen in this area when the breath pattern technique is used.

For a study of a less severe action on the surface of glass, breath patterns were observed on regular sheet glass before and after polishing. The unpolished surface showed sharply outlined fracture lines while the area immediately after polishing with a high-speed felt wheel saturated with a rouge slurry showed no fracture patterns. The depth of the polished area was approximately 2μ. After about 20 hours, the same general area contained pronounced fracture patterns. The fractures appear to be more numerous and less distinct on the aged polished surface than on the original, and they definitely did not follow the initial fracture patterns.

The latest fracture growth was studied by polishing a diamond scratch on the surface of sheet glass. This scratch was made by drawing an ordinary diamond marking pencil across the glass with a load of about 50 gm. and was intentionally made wavy so that it could easily be identified under the microscope. Immediately after the scratch was polished out (material removed to a depth of 5μ), the breath pattern technique showed that no fractures were associated with the scratched area. After 20 hours, the sample was again examined and no fractures were observed. An examination after 40 hours, however, disclosed fracture lines which followed the wavy contour of the polished scratch.

An experiment was then made to find out if the development of these fractures could be accelerated by treating the glass surface with dilute hydrofluoric acid. A small area on a sample of sheet glass was polished with the high-speed felt wheel to a depth of about 2μ. A breath pattern on this area immediately after polishing showed that fractures appeared to be absent. The sample was then placed in the dilute acid solution for 20 seconds and then rinsed. In the breath pattern after the etching, it could be seen that pronounced fracture patterns were present. Longer periods of etching did not increase the number of surface fractures. It was also found that frac-

(*Continued on page 390*)

HARLAN HOBBS NAMED GLASSCO VICE PRESIDENT

Harlan Hobbs, Sales Promotion Manager of the Kimble Glass Company, subsidiary of Owens-Illinois Glass Company, has been named Vice President of Glasco Products Company, another O-I subsidiary.

He will succeed E. M. Schumann, President of Glasco, upon the latter's retirement in December, according to R. H. Mulford, Vice President of Owens-Illinois and Kimble's General Manager.

Mr. Hobbs, a former newspaper man and West Coast advertising agency official, joined Owens-Illinois in 1945 and organized the company's Film Division, later becoming Sales Promotion Manager for Kimble.

CANADIAN POTASH DEVELOPMENTS

Saskatchewan may have as much as 100 billion tons of potash reserves, including those at great depths, and prove to be a major supplier of potassium chloride, as well as sodium chloride, with potassium compounds used for production of glass and other purposes, not only in Canadian industries but for export in substantial quantities to the United States.

Several companies are now engaged in operations to develop this resource in that area of Canada, the only area known to have large commercial deposits of the mineral. Extensive plans are expected to be put into operation to bring forth these huge deposits.

One report has indicated that Campana Ltd., Calgary, has made one of the most extensive finds thus far about four miles north of Wilkie where it is described as 100 ft. thick and 3,600 ft. below the surface with 45 ft. of pure potash and balance potash mixed with salt. The Potash Co. of America is reported to be spending about $3 million to sink a shaft in an area about 15 miles east of Saskatoon where 28 freeze holes are being drilled and work on a shaft may start this fall, this being one of the really major operations. Another operation with such obstacles is that of Western Potash which is working on a shaft near Unity where deposits are said to be 3,400 ft. down. International Minerals and Chemical Corp. and Peplar Oils Ltd. have also obtained potash withdrawal rights in certain Saskatchewan areas. Duval Sulphur and Potash are exploring 500,000 acres in the central region of Saskatchewan covering four areas.

When some large-scale problems are overcome and companies operations get into full stride, Saskatchewan potash deposits are expected to make this area of Canada one of the world's largest suppliers.

• Dr. S. Donald Stookey, senior research associate in chemistry in the Research Development Division of Corning Glass Works, has received an Alumni Award of Merit at Coe College Commencement exercises. The awards are presented annually to graduates of the College for outstanding work in their particular fields.

HUNT FOODS BUYS GLASS CONTAINERS, INC.

According to an announcement by Norton Simon, Chairman of the Board of Hunt Foods, Inc., purchase has been completed by that company of two plants of Glass Containers, Inc. and the facilities of Nevada Silica Sands, Inc. The glass plants are located at Antioch and Vernon, California, and the silica operation is near Overton, Nevada.

It is the intention of Hunt Foods to operate the two acquisitions as subsidiaries under the names of Glass Containers Corporation and Nevada Silica Sands Corporation. The food packing firm is already in the glass container and can business through a subsidiary, the United Can and Glass Company. According to Mr. Simon, Hunt's sales to other customers would be increased by about $10 million a year.

SUN GLASSES FOR BUILDINGS BY HOUZE

"Sun glasses for buildings" to increase efficiency and visual comfort on critical seeing work is the latest development of Houze Glass Corporation.

The new material, known as Lo-tran, permits the transmission of only 12.5 per cent of the outside brightness into the working area to completely eliminate all glare conditions. Neutral grey in color, the Houze product also permits outside viewing without any distortion of colors.

E. V. Ogg, company President, in announcing this achievement, said that Lo-tran has been produced to meet specifically the recommendations of the National Council on Schoolhouse Construction and many of the nation's leading architects and illuminating engineers.

NEW A.S.T.M. COMMITTEE

A new committee on electronics materials has been authorized by the Directors of the American Society for Testing Materials to cover the field of materials for electron tubes and semi-conductor devices.

The new committee, designated F-1 on Materials for Electron Tubes and Semi-conductor Devices, will be concerned with materials for electron tubes, such as mica stampings, cathodes, glass-to-metal seals, grid wires and luminescent materials used in cathode ray tubes and in fluorescent lighting.

WYANDOTTE NAMES SALES DIRECTOR

S. B. Scott has been named Director of Sales for Wyandotte Chemicals Corporation's Michigan Alkali Division. The appointment was announced at the mid-year sales rally by Bert Cremers, Vice President of the Division.

In his new position, Mr. Scott will be directly responsible for all sales and sales activities of the Michigan Alkali Division. Through the general product managers, he will be responsible for sales aids in the form of promotional plans and programs to supplement and facilitate direct selling efforts. He will collaborate with other divisions of the company on all matters pertaining to the sales of Wyandotte's products.

Mr. Scott is a veteran member of Wyandotte's sales team. He joined the firm's New York office in 1942 and was named Manager of that office eight years ago. He is a graduate of the University of Wisconsin.

Current Statistical Position of Glass

Employment and payrolls: Employment in the glass industry during April 1955 was as follows: *Flat Glass:* The preliminary 28,600 reported for April represents a decrease of .7 per cent from the previous month's 28,800. *Glass and Glassware, Pressed and Blown:* An increase of 1.3 per cent is shown in the April figure of 77,400 when compared with March's adjusted 76,400. *Glass Products Made of Purchased Glass:* The April figure of 14,700 indicates a rise of only .6 per cent over the previous month's 14,600.

Payrolls in the glass industry during April 1955 were as follows: *Flat Glass:* During April, payrolls were $13,526,084, which is a drop of 2.3 per cent from the adjusted March figure of $13,855,296. *Glass and Glassware, Pressed and Blown:* The preliminary $24,712,272 reported represents an increase of .5 per cent over the

(*Continued on page 380*)

GLASS CONTAINER SHIPMENTS
(All Figures in Gross)

	May 1955
Narrow Neck Containers	
Foods	1,114,000
Medicinal & Health Supplies	1,184,000
Chemicals, Household & Industrial	769,000
Beverages, Returnable	1,179,000
Beverages, Non-returnable	132,000
Beer, Returnable	365,000
Beer, Non-returnable	791,000
Liquors	702,000
Wines	358,000
Toiletries & Cosmetics	814,000
Sub-total (Narrow)	7,408,000
Wide Mouth Containers	
Foods	*3,085,000
Dairy Products	203,000
Medicinal & Health Supplies	411,000
Chemicals, Household & Industrial	190,000
Toiletries & Cosmetics	146,000
Packers' Tumblers	192,000
Sub-total (Wide)	4,227,000
Total Domestic	11,635,000
Export Shipments	221,000
TOTAL SHIPMENTS	11,856,000

* This figure includes Fruit Jars and Jelly Glasses.

GLASS CONTAINER PRODUCTION AND INVENTORY
(All Figures in Gross)

		Production May 1955	Stocks May 1955
Foods: Medicinal & Health Supplies; Chemicals Household & Industrial; Toiletries and Cosmetics	Narrow Neck	4,052,000	4,815,000
	Wide Mouth	*3,781,000	*4,883,000
Dairy Products		213,000	347,000
Beverages, Returnable		1,099,000	1,315,000
Beverages, Non-returnable		151,000	233,000
Beer, Returnable		335,000	375,000
Beer, Non-returnable		811,000	769,000
Liquors		769,000	917,000
Wines		386,000	499,000
Packers' Tumblers		161,000	178,000
TOTAL		11,758,000	14,331,000

* This figure includes Fruit Jars and Jelly Glasses.

FOUR YEAR SUMMARY OF GLASS EXPORTS 1951 - 1954 INCLUSIVE

Description	% 1954 vs 1953	1954	1953	1952	1951
Auto Machine Tumblers	99.2	$ 4,026,646	$ 4,057,981	$ 3,624,724	$ 6,584,390
Dozens	108.3	6,738,709	6,223,708	5,731,567	13,141,121
Average Price Per Dozen	91.6	59.7¢	65.2¢	63.2¢	50.1¢
Hand Made Tumblers & Stemware	63.4	$ 23,516	$ 37,040	$ 27,807	$ 63,979
Dozens	49.7	5,543	11,149	8,180	28,527
Average Price Per Dozen	127.7	$ 4.242	$ 3.322	$ 3.399	$ 2.243
Cook. Heat Resistant Ware	68.0	$ 1,013,600	$ 1,491,559	$ 878,804	Previously
Dozens	79.4	591,194	744,677	453,989	in
Average Price Per Dozen	85.6	$ 1.715	$ 2.003	$ 1.936	524012
Auto. Machine Made Table, Kitchen and Cooking Ware	81.3	$ 4,227,685	$ 5,199,207	$ 5,190,376	$ 7,216,994*
Dozens	90.3	4,698,971	5,205,375	5,792,217	8,212,326
Average Price Per Dozen	109.9	90.9¢	99.9¢	89.6¢	87.9¢
Hand Made Table, Art & Kitchen	69.9	$ 198,685	$ 284,111	$ 284,805	$ 366,064
Dozens	73.0	29,474	40,399	55,165	102,279
Average Price Per Dozen	95.9	$ 6.741	$ 7.032	$ 5.162	$ 3.579
Lamp Chimneys & Lantern Globes	106.2	$ 593,560	$ 558,869	$ 512,586	$ 737,289
Globes & Shades (Lighting)	97.8	$ 1,693,406	$ 1,731,394	$ 1,786,914	$ 1,711,507
Glassware Chemical, exc. Tubing	106.6	$ 2,409,103	$ 2,260,803	$ 2,378,370	$ 2,477,995
Elec. Glass Insulators	109.5	$ 272,924	$ 249,262	$ 320,296	$ 283,275
Glass Tubes, Tubing, Rods, Canes	95.3	$ 2,147,777	$ 2,254,045	$ 2,018,322	$ 3,308,709
Elec. Light Blanks	87.1	$ 1,680,774	$ 1,930,491	$ 1,277,298	$ 1,887,845
Glass Electron Tube Blanks	143.7	$ 5,742,385	$ 3,994,762	$ 1,220,241	Previously in 529300
Glass Products N.E.S.	115.0	$ 3,977,513	$ 3,460,302	$ 3,285,876	$ 3,050,484

* Heat Resistant Cooking Ware included only in 1951

Table compiled by American Glassware Association, based on data released by the Department of Commerce.

TOLEDO BUILDING TO BECOME OWENS-ILLINOIS BUILDING

Starting September 10, the 368-foot Ohio Building at Madison and St. Clair Streets in Toledo, will become the Owens-Illinois Building. At that time, a giant outdoor electric sign will be lighted featuring O-I's trademark, the familiar O with an I in the center. This will appear on all four sides of the building in neon-lighted letters 15 feet high.

On a parapet just above the 24th floor, separate signs to be erected on the nortth, south and east sides will spell out in neon lights the name, Owens-Illinois. Each of the three signs will be approximately 60 feet long with initial letters nine feet high and the remainder six feet high.

Further evidence of the building's new name will appear above the Madison and St. Clair Street entrances where black granite stones will carry in bronze letters the O-I trademark and the legend, "Owens-Illinois Building, Owned by Owens-Illinois Employees Retirement Trust Fund." The office building was completed in 1931 and became the property of the Owens-Illinois Retirement Trust Fund in 1945.

RADIATION-SHIELDING WINDOWS AVAILABLE FROM CORNING

Completely assembled radiation-shielding windows for nuclear research are now available from Corning Glass Works. Consisting of individual castings of radiation-resisting glass up to 10 inches thick stacked together in a framework, the units are shipped ready to install in test cell walls.

Used to protect research personnel by reducing radiation intensity to a tolerable level, the windows permit direct observation of work carried out remotely in "hot" areas. The new package units, which are available as either wet or dry-type assemblies, eliminate construction and assembly work at the laboratory site. Wet-type assembly windows are shipped already charged with index oil. Three special glasses with densities of 2.7, 3.3 and 6.2 are used in the package windows.

STAUFFER APPOINTMENT

The appointment of Charles A. Lindsay as General Manager of the Container Division of Stauffer Chemical Co., has been announced by Hans Stauffer, President.

THATCHER GLASS SHIFTS PLANT MANAGERS

Harry J. Mullany, Vice President and Container Factories Manager of Thatcher Glass Manufacturing Company, Inc., has announced two changes at the company's Streator and Lawrenceburg plants.

R. E. Haldeman, former Plant Manager at Streator, Illinois, has been moved to Thatcher's Lawrenceburg, Indiana, operation to manage that plant. The Lawrenceburg Plant Manager, J. K. O'Brien, has been named to replace Mr. Haldeman at Streator.

Mr. Haldeman served as Manager of Thatcher's former Olean plant and in 1945 took charge of the Streator organization. Mr. O'Brien began his Thatcher career in 1936, and in 1951 was made Plant Manager at Lawrenceburg.

HARBISON-WALKER ELECTS OFFICERS

Two new Vice Presidents and a new Director have been elected by Harbison-Walker Refracories Company, it has been announced.

C. A. Brashares has been named Vice President-Sales and A. Brent Wilson has been elected Vice President-Subsidiaries. The new Director is W. C. Robinson, Jr., President of National Electric Products Corporation.

Mr. Brashares, who has been General Sales Manager since 1954, has been associated with Harbison-Walker since his graduation from Case Institute of Technology in 1928. He started in the Research Department, then transferred to Technical Sales.

Before his appointment as assistant to the president in 1950, Mr. Wilson had been General Manager of Canadian Refractories Limited, a Harbison-Walker subsidiary. A metallurgical engineering graduate of Queens University in Ontario, he first became associated with the firm in 1934.

HAZEL-ATLAS BLACKWELL PLANT NOT TO BE REBUILT

The Hazel-Atlas Glass Company Blackwell plant, destroyed by fire after being unroofed by the recent tornado, will not be rebuilt according to Howard G. Lewis, John W. Carnahan and Karl Weaver, Vice Presidents of the company.

The executives stated that the loss is covered by insurance and a new plant will be built at another location. The Blackwell plant was originally acquired largely because of its closeness to fuel supply, some raw materials and certain markets. The plant hired about 175 persons.

SAFETY DEVICE FOR HERCULITE ALL-GLASS DOORS

New safety measures that have brought to the industry for the first time a method of designing and hanging doors in a manner which makes it impossible to catch their fingers in the opening are now being applied to Herculite all-glass doors, according to George L. West, Manager of Structural Glass Sales for Pittsburgh Plate Glass Company.

The apparatus, a safety arm assembly that prevents physical injury by minimizing the pivot space in door openings and closures, was developed by Pittsburgh Plate Glass Company. It will be known as the Pittco Safety Door Check Arm Assembly. It is installed in such a way that it reduces the standard pivot distance between door and frame from 2⅝ inches to ⅜ of an inch.

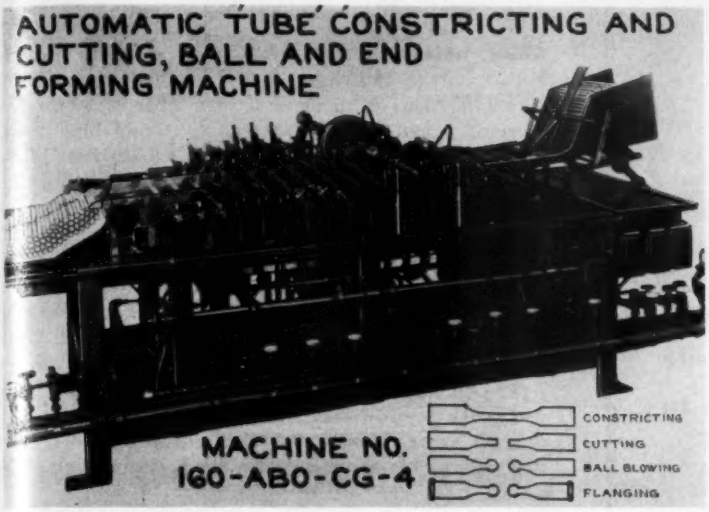
FRANZ G. SCHWALBE DIES

Franz G. Schwalbe, 57, President of The Toledo Engineering Company, died following an eight-month illness.

Mr. Schwalbe, an authority on the construction of glass melting furnaces, had been President of the firm since 1951. He served as Secretary-Treasurer for 26 years prior to that, and was the author of numerous articles on glass production.

Mr. Schwalbe received both a bachelor's and a master's degree from the University of Michigan. In 1920 he became a design engineer for the O'Neill Mechanical Company and later was sales representative for the firm in London before joining Toledo Engineering. He was a registered professional mechanical engineer in Ohio.

New Equipment and Supplies



FULLY AUTOMATIC GLASSWORKING MACHINE

Eisler Engineering Company, Inc., 750 South 13th Street, Newark 3, New Jersey, has developed an automatic tube constricting and cutting, ball and end forming glazing and flanging machine.

The new machine constricts or draws a taper, cuts apart at the constricted area mechanically by cutting wheels or flame cutting by oxygen fires, blows any shape with a flat or round bottom forming ball, glazes both ends, flanges or flares either end.

A sturdily constructed fabricated table carries the main bearings, hopper feed, glass forwarding mechanism and glass cutter. In front of the machine are the gas-air-oxygen manifolds with mixers and regulating valves for adjusting the intensity of the gas flames. It has one shot lubrication system.

The glass blank is carried from the hopper feed automatically to several heating positions. In the constricting position, the taper is drawn by powered driving rollers. In the following positions, the glass is cooled off or reheated, depending on the type of cutting (mechanical or flame cut). In the consecutive position, both ends can be formed as required. The production output of the machine is 500 to 750 per hour, depending on the nature of the work.

CUSHIONING NOMOGRAM

The Celotex Corporation, 120 South LaSalle Street, Chicago 3, Illinois, has developed a Cushioning Nomogram which tells the shipper the exact thickness of Celotex cushioning material, cane fiber insulation board, that is required for a specific shipment.

Essentially, the nomogram is a large sheet of paper with columns of figures. By using the data, a person can determine the necessary thickness of the Celotex material for an individual packaging job. All he needs to know at the start is the fragility of the merchandise, its weight, bearing area and the height of drop expected in normal handling. Projection of straight lines across the graduated columns of figures on the nomogram gives the answer.

PORTABLE POTENTIOMETER

Wheelco Instruments Division, Barber-Colman Company, Rockford, Illinois, has developed a portable potentiometer capable of providing extreme accuracy for checking installations of temperature measurement and control instruments, both in the laboratory and field.

The Wheelco portable potentiometer is readable to .025 millivolts. The scale length exceeds 40 inches. Models are also available with a built-in run-up box and calibrated rheostat for line resistance compensation. A built-in thermometer is also available for cold junction temperatures.

GLOSSMETER

Epic, Inc., 154 Nassau Street, New York 38, N.Y., American representative of Dr. B. Lange Company, Western Berlin, has announced a new glossmeter, which is an inexpensive photo-electric instrument to measure gloss and polish of glass, enamel, metals, etc.

The instrument operates at 110 volts, 60 cycles. Terminals are provided for the connection to any sensitive pointer microammeter or galvanometer for reading of the photo-electric current, which is directly proportional to the measured gloss.

CATALOGS RECEIVED

Pangborn Corporation, Hagerstown, Maryland, has issued a new 4-page bulletin, No. 919, describing the type "CW-1" centrifugal wet dust collector.

Five photographs, three line drawings and two tables give complete data on the Pangborn counter-current, wet collector of tower construction. The action of the patented vanes in dispersing the liquid to obtain greater capacity in reduced speed is described.

Diamond Alkali Company, 300 Union Commerce Building, Cleveland 14, Ohio, is distributing a helpful, handy wall chart giving 37 specific, successful suggestions based on accumulated plant experience for safely handling solids, liquid and flake caustic soda.

The wall chart, 17" x 23", is printed in two colors. It concisely presents safety recommendations covering first aid measures, protective practices and equipment, and dissolving and unloading procedures. Space is also provided for listing telephone numbers for emergency use.

Acheson Colloids Company, Division of Acheson Industries, Inc., has published a revised 4-page booklet listing 44 colloidal and semi-colloidal dispersions, including operational and mold-release lubricants for the glass, ceramics, plastics and rubber industries.

These products include dispersions of graphite, molybdenum disulfide, mica, vermiculite, zinc oxide and acetylene black. Carriers and diluents are given for each product, along with typical applications and important physical data. Eight entirely new dispersions have been added to this latest revision of Acheson's product list.

Libbey-Owens-Ford Glass Company, 608 Madison Avenue, Toledo 3, Ohio, has prepared a new technical manual on Thermopane insulating glass. The manual has been revised to include data on glazing air-conditioned buildings.

The 28-page book compares the effectiveness of single, double and triple glazing in retarding winter heat loss and summer heat gain, their light and solar radiation transmittances and surface condensation points.

Detail drawings show the proper method of glazing Thermopane and suggested framing. The book lists the standard sizes in which Thermopane is made and the manufacturers of sash for Thermopane, together with drawings of the types of sash available. Charts for specifying non-standard sizes or units with special types of glass show the maximum and minimum sizes in which the units are made, together with dimensional tolerances and weights.

HIDDEN COSTS
in
RAW MATERIALS?

Yes, often there are hidden costs in raw materials and Calumite offers advantages which help to eliminate them.

In addition to greater glass stability, easier melting and increased production, Calumite provides these extras:

- **less superstructure attack and less stone loss.**
- **markedly reduced volatile attack and batch carry-out.**
- **longer checker life and furnace efficiency.**

Calumite, in delivering these "extras", helps to eliminate the hidden costs in raw materials.

The Calumite Co.
HAMILTON, OHIO

Current Statistics • • •
(Continued from page 377)

previous month's adjusted $24,568,457. *Glass Products Made of Purchased Glass:* Preliminary payrolls were reported to be $3,943,667, or .4 per cent above the adjusted $3,926,329 for March.

Glass container production, based on figures released by the Bureau of Census, was 11,758,000 gross during May 1955. This is an increase of 6.4 per cent over the previous month's 11,045,000 gross. During May 1954, production was 11,548,000 gross, or 1.8 per cent below this year. At the end of the first five months of 1955, glass container manufacturers have produced a total of 54,640,000 gross. This is 3.5 per cent above the 52,774,000 gross produced during the same period in 1954.

Shipments of glass containers during May also rose and were reported to be 11,856,000 gross, or 10.8 per cent ahead of the 10,696,000 gross shipped during April. During May 1954, shipments were 11,071,000 gross, or 7 per cent less than for May this year. Total shipments during the January-May 1955 period have reached 52,725,000 gross. This is 5.6 per cent higher than the 49,900,000 gross shipped during the corresponding 1954 period.

Stocks on hand at the end of May 1955 were 14,331,000 gross, which is 1.3 per cent below the 14,521,000 gross reported for April and 4.2 per cent higher than the 13,745,000 gross on hand at the end of May 1954.

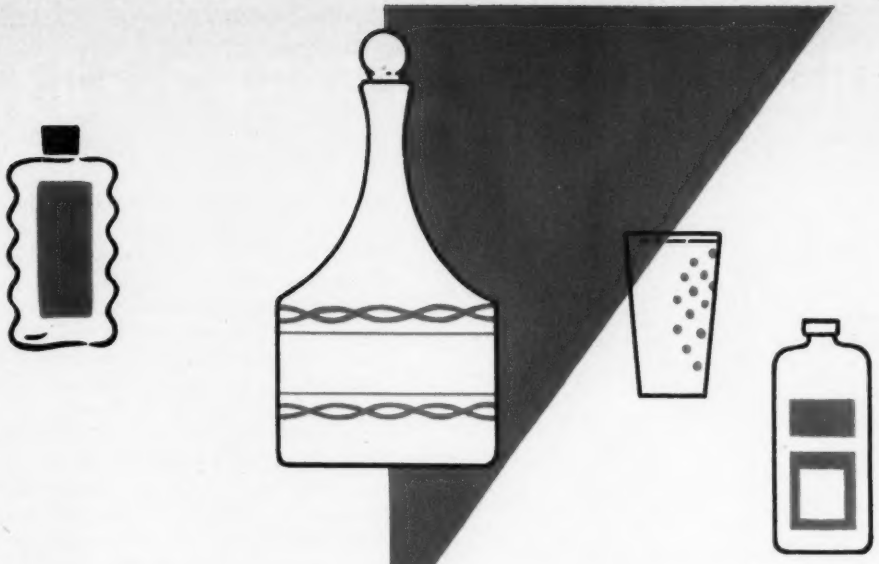
Automatic tumbler production during April 1955 fell off 3.6 per cent from March production of 5,724,878 dozens to reach 5,513,302 dozens. During April 1954, production was 6,074,989 dozens. Shipments also fell off and were reported to be 5,254,649 dozens. This is 6.5 per cent under March's 5,619,096 dozens. During April 1954, shipments were 5,858,066 dozens. At the end of the 12-month period ending April 1955, shipments were 62,114,702 dozens. This is 2.7 per cent higher than the 60,446,574 dozens shipped during the same 1954 period.

Table, kitchen and household glassware: Manufacturers' sales of machine-made table, kitchen and household glassware during April 1955 were 3,083,675 dozens. This is 16 per cent less for March when sales were 3,672,086 dozens. During April 1954, sales were 3,148,476 dozens. At the end of the 12-month period ending April 1955, manufacturers' sales had totaled 37,694,715 dozens, which is .9 per cent less than the 38,063,761 dozens sold during the corresponding 1954 period.

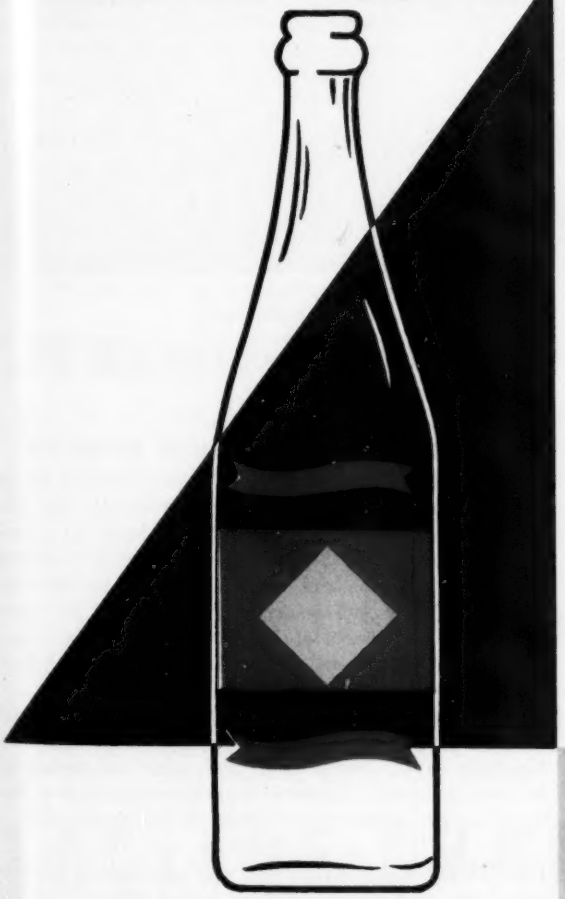
L-O-F NAMES WINDOW GLASS HEAD

Albert G. Barton, for 10 years Manager of the Charleston factory of Libbey-Owens-Ford Glass Company, has been promoted to General Manager of window glass production, with headquarters in the executive offices in Toledo.

Mr. Barton has been active with the firm for more than 28 years in various capacities. In his new post, he will have general management of all window glass operations. Mr. Barton is a graduate of the University of Michigan and received his master's degree in business administration from Harvard University in 1925. He will be succeeded at Charleston by Albert W. Swillinger, who has been Assistant Factory Manager.



Stand-out appeal for glass products



DU PONT GLASS COLORS

Give your glass packages and products sparkling sales appeal with durable Du Pont Glass Colors.

There's a complete line to meet every requirement from the simplest motif to the heaviest multi-layer designs.

Du Pont Colors resist acid and alkali . . . withstand repeated washing and sterilization. They produce smooth even coats that are stable over a wide firing range. Each color is pretested before shipment.

Our Technical Staff and Service Laboratory will help you with your decorating problems. Trial runs on your ware can be made in our laboratory or in your own plant.

Look to Du Pont for glass and ceramic colors of all types. For complete information, just write:
E. I. du Pont de Nemours & Co. (Inc.),
Electrochemicals Dept., Wilmington 98, Del.

DU PONT GLASS COLORS

DU PONT
REG. U.S. PAT. OFF.

Better Things for Better Living . . . *through Chemistry*

DISTRICT SALES OFFICES
Baltimore • Boston • Charlotte • Chicago • Cincinnati
Cleveland • Detroit • El Monte (Cal.) • New York
Philadelphia • San Francisco • Export Div., Wilm., Del.

STATUS OF CANADIAN GLASS INDUSTRY

The Canadian Government's latest annual survey of the glass and glass products industry has just revealed a spectacular increase in the factory shipments by such manufacturers, rising to $72,910,166 in 1953 over the $58,779,800 in the preceding year, a record increase of 24.2% in the gross selling value of such products for the 12-month period.

There were 118 glass and glass products factories in operation during this latest year under survey, continuing an upward trend since only 114 plants were reported in the previous year, 113 in 1951, 106 in 1950 and 102 in 1949. Number of employees also increased to 7,830 as against 6,516, a gain of 20.2%, and their salaries and wages jumped to $24,978,847 as compared with $19,102,882, an increase of 30.8%.

Cost of materials at these plants advanced to $28,552,798 as against $22,192,757, a rise of 28.7%, and cost of fuel and electricity at the works moved up to $4,232,924 as against $3,892,431, up 8.7%.

The report also discloses that the glass and glass products industry is concentrated in two provinces, Quebec and Ontario. In fact, in 1953 Ontario plants showed factory shipments of $42,313,975 and Quebec plants $24,141,152 out of the total $72,910,166 in contrast to the preceding year's Quebec shipments of $20,072,421 and Ontario's $33,309,831 out of the total of $58,779,800. In addition, Ontario reported 61 such plants and Quebec 38 in 1953 out of 118, while in the previous year Ontario had 59 and Quebec 36 such plants.

Value of factory shipments of cut and bevelled glass products reached $28,561,761 in 1953 as against $21,278,341 the preceding year. Products included were the following, the second figure being for the year earlier: Mirrors, Plate Glass, $3,512,626 ($2,929,590), Sheet Glass, $1,126,594 ($810,985), Other Products of Glass, Bevelled or Polished Edge Plate, $1,136,253 ($1,050,243), Bevelled or Polished Edge Sheet Glass, $394,286 ($313,510), Leaded Glass, including Memorial Windows, $213,864 ($232,521), Cut Glass (Tumblers, Bowls, etc.) $1,021,361 ($889,428), Decorated Glassware, including Engraved, Etched, Sand-Blasted, Applied Color, etc., $343,938 ($189,975), Druggists', Physicians' and Laboratory Glassware, $550,511 ($484,433), Other Glass Products, $18,550,130 ($13,458,635), Receipts For Repair Work, $97,198 ($99,827). All Other Products, $1,614,997 ($819,194).

Value of shipments of pressed, blown and drawn glass advanced to $44,348,405 for pressed, blown, etc., bottles, sealers, ovenware, window glass, etc., in contrast to $37,501,459 in the previous year.

Of the materials used in such manufacturing operations in 1953, cut and bevelled glass accounted for $13,239,693, cost at works, against $9,576,212 in the previous year, and pressed, blown and drawn glass for $15,313,105 against $12,616,545. Major items included the following materials, the second figure being for previous year: Plate Glass Used for Bevelling, Silvering, Laminating, etc., $7,832,468 ($5,381,441), Sheet Glass Used for Bevelling, Silvering, Laminating, etc., $1,947,292 ($1,534,694), Silica Sand, $1,939,531 ($1,596,593), Shipping Containers and Packing Materials, $4,550,827 ($3,470,075).

Canadian imports of glass and glassware advanced sharply to $37,112,273 in 1953 in contrast to $26,847,636 a year earlier, with imports of glass demijohns, carboys, bottles, flasks, phials and jars, and balls, not cut, rising to $5,792,262 against $4,480,316, glass tableware and cut glassware, n.o.p., $2,492,635 ($1,902,009), common and colorless window glass, $3,298,572 ($2,175,361), plate glass, n.o.p., $6,348,832 ($3,005,201), etc.

Exports, too, increased and reached $1,982,805 as against $521,837, with the principal export being common and colorless window glass totaling $1,317,769 against $11,461 a year earlier.

Of the 7,830 employees in 1953, supervisory and office staff comprised 909 male workers and 528 female, and production workers comprised 5,395 male and 999 female, with the supervisory and office workers being paid $5,268,094 in earnings and production workers $19,710,753. In the preceding year, supervisory and office workers comprised 691 male and 338 female, and production workers included 4,698 male and 799 female, with their earnings being $3,445,478 for the supervisory and office staff and $15,657,404 for the production workers.

Finally, total capital and repair expenditures in the glass and glass products industry during 1953 advanced to $7,619,000, including $2,836,000 for capital expenditures and $4,783,000 for repair and maintenance expenditures in contrast to preceding year's $6,426,000 including $2,259,000 for capital expenditures and $4,167,000 for repair and maintenance expenditures.

CONTROLLERS INSTITUTE ELECTS BOARD CHAIRMAN

C. R. Fay, Vice President and Comptroller of Pittsburgh Plate Glass Company, has been elected Chairman of the National Board of Directors of the Controllers Institute of America, effective September 1. Mr. Fay has previously been President of the organization.

Also announced was the election to membership in the Institute of Frank R. Matson, Comptroller of Pittsburgh Corning Corporation.

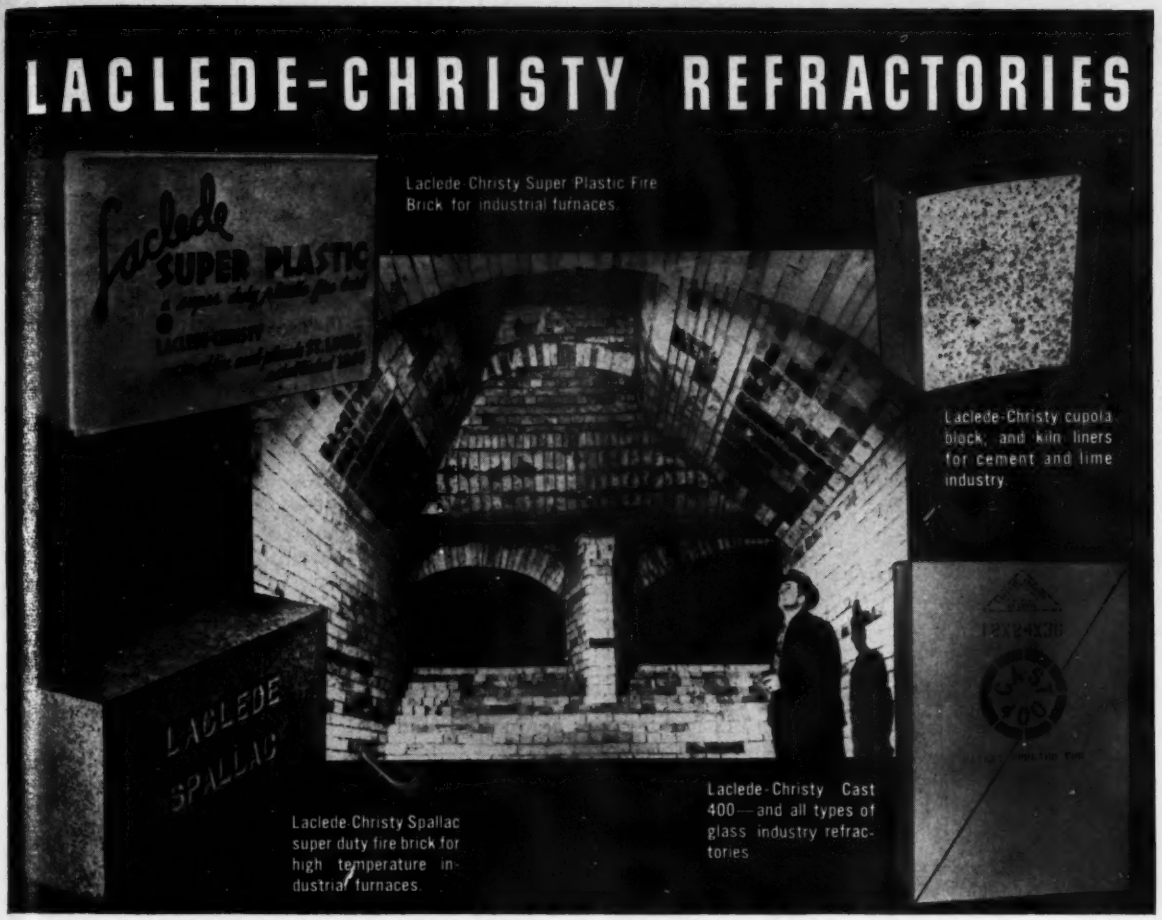
DR. ALEXANDER SILVERMAN HONORED

A special striking of the Francis Clifford Phillips Medal in Chemistry of the University of Pittsburgh was presented to Dr. Alexander Silverman, Professor of Chemistry, Emeritus, in the presence of several thousand alumni, faculty members and students. It was the occasion of the 50th anniversary of the advent of Professor Silverman as a member of the full-time staff of the Chemistry Department, the College and the Graduate School of the University.

The Chemistry Medal was established in 1915 by Professor Francis Clifford on his retirement from the Headship of the Department, and after completion of 40 years of service, for the purpose of recognizing exceptional accomplishment by graduates of the Department.

ERRATA: In connection with the article "Some European Glass Factories: Operation, Trends, History" which appeared in the April 1955 issue of THE GLASS INDUSTRY, a French glass manufacturer points out that in connection with the payment of wages for social security by manufacturers, the percentage should be 50% rather than 5% as stated in the article.

LACLEDE-CHRISTY REFRACTORIES


Laclede SUPER PLASTIC
Laclede-Christy Super Plastic Fire Brick for industrial furnaces.
Laclede-Christy cupola block and kiln liners for cement and lime industry.
LACLEDE SPALLAC
Laclede-Christy Spallac super duty fire brick for high temperature industrial furnaces.
Laclede-Christy Cast 400—and all types of glass industry refractories.

Name your refractory needs

What do you want? Not just the correct refractory for your purpose, but fire brick, blocks or liners that deliver *more* than you expect. You want benefits that go with this kind of service—minimum furnace down time, long furnace life and economical output. You also may want engineering service and follow-through for on-schedule performance.

You fill them best here

Laclede-Christy refractories—for the purpose you name—meet your most rigid requirements. "Quality first" is supported by many, many record performances. Laclede-Christy service is quick and helpful. The extra engineering help you may need is here too—at

LACLEDE-CHRISTY COMPANY

DIVISION OF H. K. PORTER COMPANY, INC.

2000 Hampton Avenue · St. Louis 10, Missouri
Mission 7-2400

Inaugurating a new era of service to the industrial heating industry

SHAMVA®

Since 1926
exclusive producers
of MULLITE brick,
special shapes and
specialties

designed for:

HIGHER TEMPERATURE APPLICATIONS

LONGER SERVICE LIFE

- ports
- tuck stones
- breast walls
- checkers
- burner blocks
- dog house superstructure
- feeders, etc.

SHAMVA special shapes are engineered to *your* specific needs.

Write for SHAMVA field engineering service.

New catalog now available

THE MULLITE REFRACTORIES CO.
SHELTON 6, CONNECTICUT

Inventions and Inventors • • •

(*Continued from page* 374)

trolling the diameter of the primary glass fiber 19, the rate of feed, temperature and velocity of the burner gas at discharge slot 25, the diameter of the drawn staple fiber can be varied. The staple glass fiber thus formed is deposited on a porous wire belt 40 that passes over the rolls 41 and 42, the roll 42 being driven by an electric motor 43 through a belt 44. A suction chamber 45 is placed on one side of the belt 40 to draw the glass fiber against the belt during deposition of the glass fiber on the belt. The glass fiber deposited on the outer face of the belt 40 forms a loose web 50 of the glass fiber of uniform diameter of one micron or less. This web 50 is removed from the belt 40 at one end and is passed to a carrier belt 51 that is preferably of a fabric material.

The web 50 impregnated with the liquid in the container 53 is then picked up by a fabric belt 55 that carries the wet web between press rolls 56 to condense the web to a more compact structure which will support its own weight upon leaving the web 55. Upon leaving the web 55, the web 50 passes over a drier cylinder 57 that has a fabric belt 58 passing around the same to retain the web 50 in engagement with the face of the heating cylinder 57. The heating cylinder is heated by any suitable source of heating such as a steam pipe 59. Upon leaving the heating cylinder, 57, the web 50 is dry and is rolled into a supply roll 60, the web now being in condition for use as paper.

The patent contains 4 claims and the following references were cited: 2,489,242, Slayter et al., Nov. 22, 1949; 2,574,221, Modigliani, Nov. 6, 1951; and 2,581,069 Bertolet, Jan. 1, 1952.

Machine for Bending Envelopes for Curved Fluorescent Lamps. Patent No. 2,696,697. Filed June 9, 1951. Issued December 14, 1954. Six sheets of drawings (none reproduced). Assigned to Westinghouse Electric Corporation by Charles Wiener and Frank J. Camarata.

An object of the invention is to provide a machine which lehrs tubular phosphor-coated bulbs or envelopes for discharge lamps and automatically forms the lehred coated envelopes into the desired curved configuration. When a bulb reaches the last roller of the lifter-feeder mechanism, it is automatically dropped into a lower molding die. An upper molding die follows immediately and forms the bulb to the desired shape. During forming, a gas such as nitrogen is automatically blown into the bulb to shape the body of the bulb against the walls of the mold. The upper molding die is then retracted and the lehred formed bulb expelled from the lower molding die by the simultaneous rotation and lowering of the turret.

The patent contains eight claims and the following references were cited: 1,707,203, Thornley, Mar. 26, 1929; 2,260,517, Hamilton, Oct. 28, 1941; 2,314,173, Sperlich, Mar. 16, 1943; 2,494,871, Greiner, Jan. 17, 1950; 2,494,872, Greiner et al., Jan. 17, 1950; 2,527,249, Gallagher, Oct. 24, 1950; 2,566,014, Archbold, Aug. 28, 1951; and 2,575,746, Cartun, Nov. 20, 1951.

• W. S. Lowe, President of A. P. Green Fire Brick Company, was elected President of The Refractories Institute at its annual meeting.

Milk-Pad Test Demonstrates

LOW INSOLUBLE RESIDUE

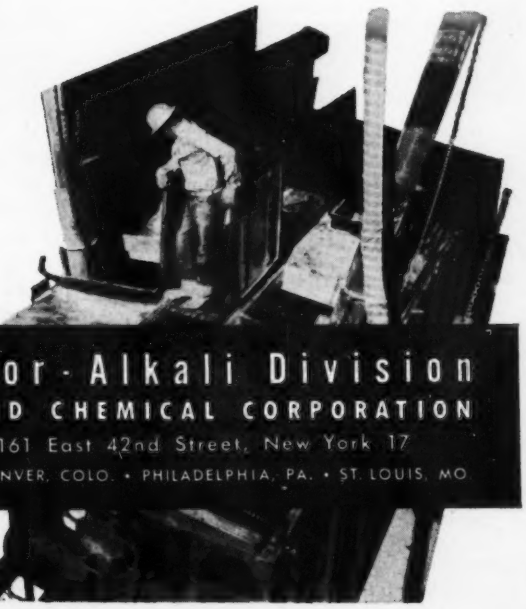
in Westvaco® Soda Ash

The American Public Health Association uses this test to determine the insoluble impurities in milk. But the milk-pad test also graphically shows the low insoluble residue in WESTVACO Soda Ash. There's a very simple "reason why" this is so!

To make WESTVACO Soda Ash, we mine thousands of tons of unbelievably pure trona underlying our Westvaco, Wyoming plant. Then we crush it and dissolve it. Right here insoluble impurities drop out. They never do get to the crystallizer or the calciner from which refined soda ash emerges as the end-product of our patented process.

Low insolubles is only one of its inherent qualities. Others are low iron, low salt and sulfate, low calcium. Equally important are high purity (99.8% Na_2CO_3), high rate of dissolution and exceptional flowability.

Users from the Mississippi Valley to the Panhandle to the Pacific benefit by this nearby source of high quality soda ash. May we send samples and quote?



fmc FOOD MACHINERY AND CHEMICAL CORPORATION

Westvaco CHEMICALS

Westvaco Chlor-Alkali Division

FOOD MACHINERY AND CHEMICAL CORPORATION

General Offices • 161 East 42nd Street, New York 17

CHARLOTTE, N.C. • CHICAGO, ILL. • DENVER, COLO. • PHILADELPHIA, PA. • ST. LOUIS, MO.

Bubbles in Glass • • •
(*Continued from page* 361)

There is one more approach to the bubble problem which I would like to mention and this approach is also an approach to a lot of other problems for that matter. I refer to statistical analysis of production and quality data. Up till now I have talked about controlled experiments and experiences which are similar or perhaps analogous to the practical bubble problems of actual glass production. Let us now shift to a consideration of direct examination of factory bubble count data by statistical analysis and quality control. In the first cases, we tried to synthesize idealized experiments. We now turn to direct analysis of production operations.

The words Quality Control have misled some people into believing that this sort of statistical analysis is synonymous with difficult government specifications which had to be lived up to. I am not thinking of the specification phase of Quality Control at all. I am thinking and talking about a running graph of the intensity of a defect with time, in comparison with its probability distribution of occurrence assuming that the process is operated uniformly. Such process uniformity is called "in control" by the statistician. The study of variability in a process with time, to decide whether or not operating conditions are constant with time, does have some value.

I just want to take a minute to be sure that everybody understands this approach. Human beings as well as machines are creatures of habit. Workers with or without machines establish a habit pattern of the process which is being carried out. The statistician discovers this pattern and then looks for deviations from the pattern and says these deviations have correctable causes which can be found.

At one of our Libbey-Owens-Ford factories, a particular furnace experiment was arranged for to decide once and for all whether furnace operation method A or furnace operation method B produced the better metal quality in our glass. The words "metal quality" mean the intrinsic quality of the glass itself: "bubbles and cords." To be absolutely sure that the experiment would be decisive, I suggested that bubble counts be made on samples taken every two hours for 48 hours before the change for comparison with the bubble count on bi-hourly samples for 48 hours after the change. In addition, during a period of ½ hour before the change, bubbles were counted on samples taken every ½ min. for the express purpose of looking for very short time fluctuations.

The program was carried out and the data were assembled and I am sorry to say that the actual charts which were made some years ago have been thrown out. Those of you who are familiar with quality control charts will know exactly what I mean when I say that all the bubble counts taken were completely out of control. The bubble counts on samples taken before the furnace change were out of control and the bubble counts on samples taken after the furnace change were out of control and there was no statistical relation between the two. It is likely that your company has made similar experiments with equally discouraging results. In other words, the furnace plus the people operating the furnace were together not achieving a habit pattern or normal distribution. Other forces and causes were overshadowing what habit pattern there was. Perhaps this is why furnace operators get almost superstitious.

You have all heard and probably practiced the very good maximum, "When the glass is bad, leave the furnace alone. It will straighten itself out." This approach to curing trouble with any operation is, however, tacit recognition that variables beyond your control exist. Recognizing that you have problems which are not in control does not mean that you can cure them, but recognition is certainly the first step.

Figure 2 of a $\overline{X}$ and R chart shows actual bubble counts on glass samples taken from a machine over a period of nearly 4 months. The data was chosen "at random" as a succession of typical bubble counts and there was nothing unusual about the machine chosen or the period of time. Each point on the X-bar chart is the average number of bubbles in 3 counts taken on each day of the period. Each point on the lower R chart represents the range or difference between the highest and lowest number of bubbles in the 3 counts each day. The average of the range value $\overline{R}$ is related by a simple factor to the width of the bell-shaped normal distribution which all normal processes are supposed to have. The upper and lower limit lines marked $UCL_{\overline{x}}$ and $LCL_{\overline{x}}$ should, according to the normal relation between R and the width of the bell, enclose 99.7% of the data. Every time a point is above or below the limit lines, this says the *process has changed.*

By inspection, how often would you say that the process changed in this example on the slide? My first guess was that the chart included three different performance patterns, so I decided to chop it up and test that theory. In fact, I thought that since $\overline{X}$ and R charts are theoretically not the best choice for bubble count data, I would study the data by histogram first as in Fig. 3 to see what sort of symmetry there was. The top histogram, which simply tabulates the data into pockets according to frequency of occurrence, has almost no similarity to the bell curve which represents the limit lines in Fig. 2. But, if we plot the three periods separately, as shown below, three individual bells of pretty good shape result. Fig. 4 shows the same data plotted with three sets of average and limit lines.

Now the point I wish to make with this simple analysis is that though we have guessed quite successfully that in the 4-month period, we were operating 3 successive processes with bubble count level and spread quite different from each other, none of the 3 individual periods was in statistical control with itself.

On the right hand chart, the range points are well in control and the X-bar points are actually all within the limits though the histogram showed more points than there should be right close to the upper and lower limit lines. But with the July out-of-control performance averaging 30% less bubbles than in August, there is little satisfaction from the apparent control in August. If bubble counts in glass are inclined to be out of control while experience in other fields indicates that when an operation is out of statistical control, the causes can be found, in over half the cases, they say. This indicates opportunity for finding causes and lowering the bubble counts in our glass.

Some excellent results have been obtained from other statistical analyses of a nature similar to the above story which was deliberately chosen to illustrate the orneriness of bubbles. The statistician can calculate degree of correlation between bubble count or other defect data and

operational characteristics of the furnace. One of the easiest correlations occurs when a periodicity or cycle is found in the defect data. If the period equals the fill cycle, the furnace reversal cycle, or some periodicity in the machine cycle or any other routine scheduled maintenance in the normal operation of the furnace, this in itself is a pretty good evidence of correlation.

To summarize, my purpose has been to try to throw some light on defining the problem of bubbles in glass. The basic thesis, which I believe is inescapeable, is that bubbles are formed only at points of inhomogeneity in a melt. Second, I think we should not overlook the possibility that some of the bubbles in our glass are formed after the batch has melted to a quiescent state. This condition may be quite different with different compositions under different melting conditions, but I believe it is a source of much trouble. Thirdly, let us not misbelieve the results of laboratory crucible melts. I strongly urge you to carry out laboratory tests in platinum-rhodium or other crucibles under controlled conditions in your own laboratories. Change the atmosphere, change the temperature, introduce samples of refractory or what have you and find out what happens after different melting times. You will learn worthwhile facts. Admittedly the interpretation of these facts into the complicated melting process in a big tank is difficult and you should not too readily try to draw simple conclusions by analogy. The strong laboratory evidence favoring high temperature melting and fining is, however, a challenge which is being realized more and more in practice.

The fourth thought which I would like to leave with you is the interpretation of the out-of-control bubble charts with time. A good statistician is likely to be able to produce proof from your data that the conditions in your furnace are not constant and that your glass quality suffers because of furnace operation fluctuations. I have often wondered how much improvement in glass quality would be achieved if we should enclose our existing furnaces inside of a closed air conditioned chamber. I have often wondered how much the glass convection currents in a glass tank change between night and day and between that hot summer day with a southwest wind blowing and the day of the cold northeaster which does blow through the factory once in a while and often during the same week, sometimes the same day, as we had the hot breeze from the opposite direction. In the steel industry, the open hearth furnace makes many melts each day and the melt is fluid like water anyway so weather changes are unlikely to affect them.

In the glass business, even our modern high-speed tanks are hardly melting their capacity in a 24-hour day. Even if they did, the glass batch which is fed today is not converted into ware the same day. The major portion of the glass in a tank lingers and circulates and may travel to a previously stagnant corner and bring trouble back into the stream from there. Running bubble count charts with time and the effort to correlate changes in bubble count with changes in furnace operation can point the way toward operating our furnaces with less bubble trouble.

• William C. Decker, President of Corning Glass Works, has been presented with the Distinguished Alumnus Award of the Pennsylvania State University.

Milestones in Glass Progress

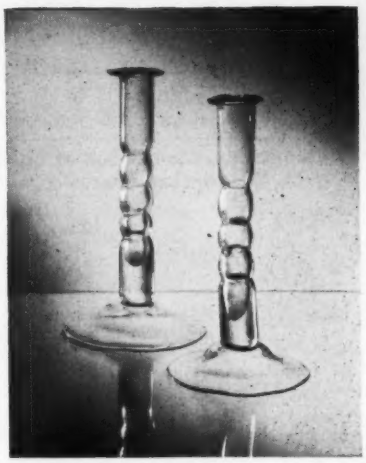
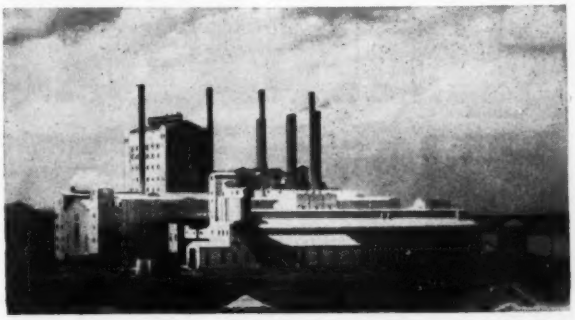


PHOTO COURTESY THE CORNING MUSEUM OF GLASS

1739 Caspar Wistar founded the famous Wistarberg Glass Works despite England's ban on Colonial manufacture. These "South Jersey" candlesticks of green bottle glass are among a dozen existing pieces attributed to the Wistarberg factory. Candlesticks of this period are rare — blown for "fun, friend or family," not for commercial use.



1890 Michigan Alkali Company, now a division of Wyandotte Chemicals Corporation, was founded by Captain I. B. Ford to supply Soda Ash to the glass industry; part of Wyandotte's modern Soda Ash facilities is shown above. Wyandotte has literally grown up with glass. Today, as in the past, it is a working partner, supplying technical assistance and raw-material chemicals to those great companies marking milestones in glass progress.

Wyandotte
CHEMICALS

Wyandotte Chemicals Corporation, Wyandotte, Michigan
Offices in Principal Cities

Founded by a Glassmaker to Serve the Glass Industry

Ancient Glass • • •

(*Continued from page* 362)

concentration of water in the outer layer, amounting to several per cent, a glass remains clear and apparently unchanged. A determination of the loss on ignition at 600°C. should therefore be made and when the amount is known, the composition of the glass should be calculated on the basis of the ignited, water-free specimen. Only on the basis of water-free samples can the comparison of different glasses lead to valid conclusion.

In the case of specimens in which the action of water has proceeded to the stage of breaking down the glass surface and leading to substantial weathering and the leaching out of soluble constituents, the material of the specimen will consist, in general, of two parts which can in some instances be clearly and cleanly separated: an inner, clear glassy part and an outer, soft flaky section comprising the residue from the weathering action up to that stage. The analysis should be carried out on the inner, clear glassy part. Interesting, additional information about the course and extent of the weathering action can be obtained by analyzing the outer, weathering product, but the analysis of this alone cannot be relied on to give the composition pattern of the glass itself. If for any reason the analysis has been carried out on a weathered specimen, a statement of the ex-

Table I
Fragment of Bowl from Nimrud

% Composition of the Clear Glass Stripped from the Weathering Products.

	%
SiO_2	71.54
P_2O_5	0.11
Al_2O_3	0.48
Fe_2O_3	0.91
TiO_2	0.19
CaO	4.82
MgO	3.07
Na_2O	12.70
K_2O	0.88
MnO	0.025
CuO	—
Sb_4O_6	0.25
SO_3	0.99
Loss on ignition	4.58

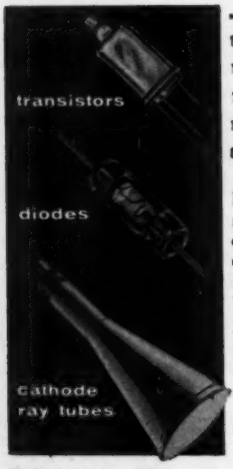
BaO, Cr_2O_3 and B_2O_3 tested for and proved absent.

Table II
Constituents to be sought for.

SiO_2	MnO
P_2O_5	CuO
B_2O_3	Cu_2O
Al_2O_3	CoO
Fe_2O_3	Cr_2O_3
TiO_2	Na_2O
CaO	K_2O
MgO	Sb_4O_6
PbO	Cl
BaO	SO_3
	Loss on ignition.

for modern, profitable automatic production...

...call on KAHLE



... world's leading exclusive manufacturer of production machinery for the electronic and allied fields

If you're making (or plan to make) *diodes, transistors, sub-miniature, miniature, cathode ray tubes, or other electronic tubes or component parts,* take full advantage of Kahle's invaluable experience.
With Kahle methods and "know-how" you're sure of getting exactly the right machinery to produce exactly what you want ...accurately, dependably, profitably.
For more than a quarter of a century the leaders in the electronics field have relied on Kahle for production machinery.
Typical production steps automatically performed by Kahle equipment include sealing, bulb making, stem making, exhausting, grid winding, filament coil winding, lead wire welding.

Write for information on special experimental and research services offered by Kahle.

Write today for additional details, equipment specifications, production data, and quotations.

Kahle ENGINEERING COMPANY
1310 SEVENTH STREET • NORTH BERGEN, N. J.

NO ONE MAKES A BETTER SILICA

The qualities that make near perfect silica are endowed by nature—they are inherent in the raw material itself.

OTTAWA SILICA SANDS

Few areas of the earth contain deposits to equal those at Ottawa. Few indeed are the refining processes to equal that which Ottawa Silica Company employs to insure you of one of the finest products in the world.

We ship via two of the nation's trunk line railroads—your guarantee of speedy, efficient service.

THE WORLD'S FINEST SILICA

OTTAWA SILICA COMPANY
PLANTS LOCATED IN OTTAWA, ILL. AND ROCKWOOD, MICH.

SERVING THE FOUNDRY, GLASS, CERAMIC AND CHEMICAL INDUSTRIES FOR OVER 50 YEARS

tensiveness of the weathering should accompany the analysis.

In conclusion, two tables have been prepared in order to illustrate and to summarize the points of this short paper. Table I sets out the results of an analysis made in 1952 of a fragment of an Assyrian glass bowl of the VIIth century B.C. found by M. E. L. Mallowan in 1951 on the site of the ancient city of Nimrud. Table II is a list of the constituents of ancient glasses for which a research should be made, followed by determinations of their amounts where significant. It would definitely be helpful if the analyst would include both a statement of all the results obtained and of the tests which were not made for any of the constituents of Table II.

COLUMBIA-SOUTHERN APPOINTMENTS

A series of appointments in the Market Research and Development Department of Columbia-Southern Chemical Corporation has been announced by W. F. Newton, Manager of Market Research and Development for the firm.

Foster G. Garrison, formerly an assistant to Mr. Newton, has been appointed Director of Market Research. Chester J. Stroemple, who also has been serving as assistant to Mr. Newton, becomes Director of Market Development. Eugene D. Witman, formerly Manager of Agricultural Chemical Development, has been named assistant to Mr. Stroemple, and Louis B. Taylor, who had been a technical representative of market research and development, has been appointed Manager of Pulp and Paper Development.

GLASS DIVISION FALL MEETING

The Fall Meeting of the Glass Division of the American Ceramic Society will be held at Bedford Springs, Pa. on September 15 and 16.

Papers dealing with the strength of glass are being encouraged since the Symposium Committee is planning a panel discussion on this subject.

NEW BOARD MEMBER ELECTED BY PEMCO

Benjamin F. Deford, Jr., Secretary of Pemco Corporation, was elected a member of the Board of Directors at their last meeting, according to an announcement by Richard H. Turk, Chairman.

Mr. Deford has been with Pemco since 1943, and in 1947 became Secretary of the company. Prior to joining Pemco, he was associated with the Union Trust Company of Maryland for a period of eight years.

PANGBORN NAMES SALES MANAGER

Arthur J. Buckley has been promoted to Sales Manager from his former position of Assistant Sales Manager of Pangborn Corporation.

Mr. Buckley served as Assistant Sales Manager of the firm since 1952 when he joined Pangborn after many years of sales work with Harnischfeger Corporation.

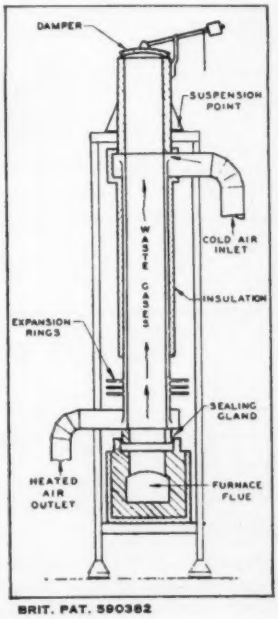
$AVE FUEL

INSTALL A METAL
AUSTEEL-ESCHER
RECUPERATOR

FOR GLASS MELTING FURNACES

Individually Designed for your Particular Requirements

★ Write us for particulars ★



BRIT. PAT. 590382

TOLEDO ENGINEERING Company

PHONE - KLONDIKE 1529

DESIGNERS AND BUILDERS OF GLASS MELTING FURNACES

3001 SYLVANIA AVENUE, TOLEDO 13, OHIO

(*Continued from page 375*)

tures could be immediately observed around polished diamond scratches after the etching, whereas, as was previously found, many hours are needed if no etching is employed.

The action of water on a glass surface may be observed even though the water is applied for a relatively short time. Samples of sheet glass were cleaned in the usual manner and dried. Double-distilled water was then run onto the glass in streaks. The sample was left 5 minutes until the water evaporated. It was then rubbed with tissue and the breath film was formed. The area that had been in contact with the water was observed to possess a finer structure than the surrounding untreated area. Such streaks demonstrate an actual chemical attack on the glass surface by the water and such streaks could be removed by recleaning with the calcium carbonate but could not be erased by repeatedly forming the breath film and rubbing with tissue. This test indicates the marked sensitivity of the breath figure to changes in surface conditions.

Editor's Note: For an interesting series of photomicrographs which illustrate this breath figure technique, the original paper should be consulted.

L-O-F GLASS FIBERS DIVISION EXPANSION

An expansion program involving expenditures of $250,000 in the next 12 months has been announced for the Corrulux Division of the L-O-F Glass Fibers Company by R. H. Barnard, President.

The expansion program includes installation of continuous production lines designed especially for panel manufacture, extension of present buildings to house the new lines and the complete revamping of present production equipment. When the new facilities are completed, the Corrulux plant will have a productive capacity of 20 million square feet of panel per year, making it the largest plant of its kind in the world.

WINNERS IN SAFETY CONTEST

Plants of Pittsburgh Plate Glass Company, Owens-Illinois Glass Company and the American Radiator & Standard Sanitary Corporation took top places in the National Safety Council's Glass and Ceramics Safety Contest for 1954.

Seventy-five contestants working a total of 106,599,000 man-hours finished the year with a 9 per cent decrease in injuries as compared with 1953. The companies reported a total of 567 disabling injuring during 1954.

Leading plants in the four divisions of the contest were: *Flat Glass:* Pittsburgh Plate Glass Company, Works No. 6, Ford City, Pa., with a perfect record. *Glass Products:* Group A, Owens-Illinois Glass Company, Charleston, W. Va., with a rate of .46. Group B, Owens-Illinois Glass Company, Clarion, Pa., with a perfect record. *Ceramics:* Group A, American Radiator & Standard Sanitary Corp., New Orleans, La., with a perfect record. Group B, American Radiator & Standard Sanitary Corp., San Pablo Works, with a perfect record. *Machine & Mold Shops:* Owens-Illinois Glass Company, Oakland Centray Mold Shop, with a perfect record.

LACLEDE-CHRISTY APPOINTMENTS

O. A. Olson has been promoted from project engineer to Assistant Director of Research at Laclede-Christy Division, H. K. Porter Company, Inc.

Mr. Olson, a graduate ceramic engineer, has been with the firm for 17 years, eight years in Production and nine years in Research. He is a member of the American Ceramic Society and other professional organizations.

Name Personnel Director at Laclede-Christy is James W. Monroe. Mr. Monroe is a graduate of Central College and is a former special agent of the F.B.I. More recently, he did personnel work in the Security Division of McDonnell Aircraft Company and at A.C.F. Industries, Inc.

HARBISON-WALKER NAMES GENERAL SALES MANAGER

Richard S. Moore has been appointed General Sales Manager of Harbison-Walker Refractories Company, according to an announcement by that firm.

Mr. Moore has been Assistant General Sales Manager since 1953, and prior to that was Manager of Basic Sales. He first became associated with the company in 1929, serving in a variety of production posts before transferring to the Sales Technical Department. A recognized authority on basic refractories, Mr. Moore has made many contributions in the development of refractories for steel and other industries.

THE SHARP-SCHURTZ COMPANY

CHEMISTS AND CONSULTING ENGINEERS FOR THE GLASS INDUSTRY

LANCASTER, OHIO U. S. A.

WISSCO *improved* LEHR belts

- **Heavy load capacity with less distortion...because of true guiding, flatness and flexibility of Wissco construction.**
- **Low thermal capacity, complete heat circulation and minimum surface contact of ware...because of open mesh.**
- **High resistance to heat and corrosion...because of wide choice of aluminized and low-chrome alloys.**

THE COLORADO FUEL AND IRON CORPORATION—Denver and Oakland
WICKWIRE SPENCER STEEL DIVISION—Atlanta • Boston • Buffalo • Chicago • Detroit
New Orleans • New York • Philadelphia

WISSCO BELTS

2688

CLASSIFIED ADVERTISING

HELP WANTED

WANTED

Ceramic engineers with experience in glass melting, plate glass processing and sheet glass lamination.

Salary commensurate with experience and ability, best of working conditions, high degree of security, and important fringe benefits.

Write
Box 175

c/o THE GLASS INDUSTRY
55 West 42nd St. New York 36, N. Y.

CHIEF ENGINEER, familiar with all phases of glass plant engineering, capable of supervising engineering, estimating and construction in mechanical, electrical and construction fields. Salary commensurate with ability and experience. State qualifications and experience in letter. Reply Box 173, c/o The Glass Industry, 55 W. 42nd St., New York 36, N.Y.

MOLD DESIGN ENGINEER. Experienced in container designs interested in employment with West Coast bottle manufacturer. Reply P. O. Box 3758, Terminal Annex, Los Angeles, California.

GLASS CONTAINER MANUFACTURER has an opening for a young man in quality control work. Experience desirable but not essential. Age 25 to 30. Reply in confidence, giving background in detail and salary expected, to Box 174, c/o The Glass Industry, 55 W. 42nd St., New York 36, N.Y.

SITUATION WANTED

GLASS TECHNOLOGIST, 30 years old with Ph.D., 5 years industrial experience in glass industry seeks responsible position in research and development work. Reply Box 176, c/o The Glass Industry, 55 W. 42nd St., New York 36, N.Y.

HAYS CORPORATION PURCHASES EQUIPMENT COMPANY

The Metrotype Corporation, manufacturer of data reduction equipment, has been purchased outright by The Hays Corporation. Digital recording equipment for the power and process industries, as well as tie line load control systems for electric utilities, are Metrotype's principal products.

George Foster, President of Metrotype, will continue to serve in this capacity and also becomes a member of the Board of Directors of Hays. Edwin M. Corson, Jr. remains as Vice President. Manufacturing operations of Metrotype and Hays will continue to be separate.

BOOK REVIEW

Petrographic Mineralogy
By Ernest E. Wahlstrom

All the information necessary for the correct identification and classification of minerals and rocks under the polarizing microscope or various other petrographic methods is supplied in this new book.

Petrographic Mineralogy offers complete explanations of techniques, gives descriptions of minerals as they are seen under the polarizing microscope, furnishes tables for use with the petrographic miscroscope and provides condensed summaries of rock classifications.

Published by John Wiley & Sons, Inc., 440 Fourth Avenue, New York, New York; 408 pages; Price, $7.75.

DELOS M. PALMER & ASSOCIATES
Consulting Engineers
Reg. Mechanical, Electrical & Industrial

•

Designers of
Special Purpose Machinery
For The Glass Industry

•

4401 JACKMAN ROAD **TOLEDO 12, OHIO**
Telephone: Kingswood 9611

When you use *Cullet*, your batch will melt at a much lower temperature and will

PROLONG THE LIFE OF YOUR TANK

Quality Cullet Since 1900

THE BASSICHIS COMPANY
2321 W. 3rd St. **Cleveland 13, Ohio**

EISLER Equipment
solves glass problems!

Since 1920, designers and builders of special machinery and equipment for the glass industry . . .

Glass Lathes • Glass Cutters • Wet or Dry Silent Blast Torches • Cross Fires • Ribbon Fires • Gas and Oxygen Burners • Indexing Turntables • Sealing, Ampule and Bulb Blowing Machines, etc.

Call us now without obligation

Above: SPECIAL CROSSFIRES
Below: BLAST BURNERS

EISLER ENGINEERING CO., INC.
742 SO. 13TH ST., NEWARK 3, N. J.

Charles Eisler, Jr.
President

SHADOGRAPH

. . . the scale for every precision weighing job

SHADOGRAPH's shado-edge indication is projected by a beam of light, eliminating all friction of indicating mechanism and increasing visible accuracy over 300%. Short lever fall plus the action of an hydraulic damper stops indicator quickly for a faster, more accurate reading. Light beam indication can be read from any angle without danger of parralax. SHADOGRAPH Scales are ideal for precise compounding, for weighing costly materials, and many other uses calling for extreme accuracy. Model 4106-B shown above, has rated capacity of 6 lbs, sensitivity as fine as 1/80 ounce or 350 milligrams. Other models with still finer sensitivity and complete range of capacities available.

Sales and Service Coast to Coast

Exact Weight Scales

Better quality control
Better cost control

THE EXACT WEIGHT SCALE COMPANY

952 W. Fifth Avenue, Columbus 8, Ohio

In Canada: P.O. Box 179, Station S, Toronto 18, Ont.

Please send complete information on Shadograph Scales.

Name .....

Address .....

City ..... **Zone** .... **State** .....

INDEX TO ADVERTISERS

	Page
American Potash & Chemical Corp.	351
Bassichis Company, The	391
Calumite Company, The	380
Carborundum Company, The	350
Classified Advertising	391
Corhart Refractories Company	343
Drakenfeld & Co., Inc., B. F.	355
du Pont de Nemours & Co., Inc., E. I.	381
Eisler Engineering Company	391
Exact Weight Scale Company	392
Frazier-Simplex, Inc.	341
General Refractories Company	347
Harbison-Walker Refractories Company	353
Harshaw Chemical Company, The	356
Kahle Engineering Company	388
Kaiser Aluminum & Chemical Sales, Inc.	345
Kirk & Blum Manufacturing Company	Cover II
Laclede-Christy Company	383
Mullite Refractories Company	384
Olin Mathieson Chemical Corp., Industrial Chemicals Division	349
Ottawa Silica Company	388
Overmyer Mould Company	344
Pacific Coast Borax Company	346
Palmer & Associates, Delos M.	391
Sharp-Schurtz Company	390
Solvay Process Div., Allied Chemical & Dye Corp.	352
Surface Combustion Corp.	Cover IV
Taylor Sons Company, Chas.	Cover III
Toledo Engineering Company	389
Walsh Refractories Corp.	348
West End Chemical Company	354
Westvaco Chemical Div., Food Machinery & Chemical Corp.	385
Wickwire Spencer Steel Div., Colorado Fuel & Iron Corp.	390
Wyandotte Chemicals Corp.	387